Effect of CPAP application on newborn baby to decrease neonatal mortality rate in NICU in Slemani City

Kurdistan\Iraq

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Signed Statement of Original Work

This dissertation contains no material which has been accepted for the award of any other degree or diploma in any university. To the best of my knowledge and belief this dissertation contains no material previously published by any other person except where due acknowledgement has been made.

Signed: ----------Soran Taher----------

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List of Abbreviation

CPAP:	Continuous positive airway pressure
RDS:	Respiratory distress syndrome
MAS:	Meconium aspiration syndrome
NICU:	Neonatal intensive care unit
TTN:	Transient tachypnea of newborn
CXR:	Chest x ray
CBC:	Complete blood count
CRP:	C-reactive protein
NMR:	Neonatal mortality rate
HR:	Hart rate
RR:	Respiratory rate
PaO2:	partial pressure of oxygen in the blood
Kg:	Kilogram
TPN:	Total parenteral nutrition
PaCO2:	Partial pressure of carbon dioxide in the blood
HCO3:	Bicarbonate
IUGR:	Intra uterine growth retardation
KRG:	Kurdistan regional government
ENM:	Early neonatal mortality
LNM:	Late neonatal mortality
WHO:	World health organization
UNICEF:	United Nations children’s fund
MDG:	Millennium development goal

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Abstract

Neonatal mortality rate can be defined as the number of deaths after delivery and before 28 days of life, which is different in number and causes from country to country, ranging from high mortality in developing country to low mortality rate in the developed country.

CPAP (continuous positive airway pressure) is discovered in 1971, but its first use in Kurdistan was in 2012.It is the application of a positive pressure to the airway of a spontaneously breathing infant throughout the respiratory cycle.

Slemani is located in the northeast of Kurdistan/Iraq; there is only 20-beds Neonatal intensive care unit (NICU) in the obstetric and gynaecological hospital,which receives neonates from this hospital, and another neonatal intensive care unit in paediatric hospital which consists of 25 beds.

The study was cross-sectional, collecting prospective data of neonatal mortality rate and its leading causes of death below 28 days in Slemani city and effect of CPAP in decreasing this rate during 2013 and comparing it to the retrospective data of 2011. A typical calculating system and quantitative approach were used to analyse the data. Data collection was through administration of a questionnaire to the patient's guardians. Total number of cases in this study was 156 and number of deaths was 26 (16.6%), those with <1.5 kg 14 cases (9%),1.5-2.5kg birth weight in 11 cases(7%) and more than 2.5 kg only 1 case(0.6%).The main cause of death was prematurity, respiratory distress syndrome, infection like sepsis and necrotizing enterocolitis.

When comparing the recent data to retrospective data especially for admission and mortality rate, the number of admission increase in 2013 (1573 cases more than 2011), however, the mortality rate decreased by 1%, It is statistically significant,because the p-value is less than the common alpha (0.05). We see a notable effect of reducing the mortality rate when using CPAP.

Chapter One: Introduction

Introduction A

Neonatal mortality is the number of deaths after delivery and before 28 days of life, which is different in number and causes from country to country pronounced differences are reported between developed and developing country.

Globally it's estimated that 130 million infants born each year, 10.6 million deaths in children younger than the age of 5 years happen over the world.The main causes are asphyxia at birth (8%), malaria (8%), neonatal pneumonia or sepsis (10%), preterm delivery (10%), pneumonia (19%), diarrhea (18%) and other remaining causes (27%)[1].

4 million neonates passed away in the first 28 days of life. 75% of neonatal deaths occur in the first week, and more than one-quarter occur in the first 24 hours. Worldwide neonatal deaths account for 40% of deaths under the age of 5 years. Therefore, efforts to achieve the UN Millennium Development Goal 4 of reducing childhood mortality rate by two-thirds by 2015 are concentrated on reducing neonatal deaths in high-mortality countries. Infection (36%), preterm birth (28%) and birth asphyxia (23%) account for 87% of neonatal deaths worldwide[2].

CPAP (continuous positive airway pressure) is the application of a positive pressure to the airway of a spontaneously breathing newborn throughout the respiratory cycle. Its main use is to prevent bronchopulmonary dysplasia and to treat many cases like: Respiratory distress syndrome,apnea, birth asphyxia,congenital pneumonia and sepsis[3].

Slemani is located in the north east of Kurdistan/Iraq, with more than 1.700.000 people, there is only 20-beds Neonatal intensive care unit(NICU) in the obstetric and gynecological hospital who receive neonates from this hospital, and another neonatal intensive care unit in pediatric hospital which consists of 25 beds; main cause of admission in this unit is preterm baby,infection,convulsion,congenital heart diseases, neonatal jaundice, transient tachypnea of neonate,congenital anomaly of the body,infant of diabetic mother and birth asphyxia. Each day nearly 15-20 cases are admitted here and the neonatal mortality rate is 20-27cases per 1000 live birth[4].

A.1 Objective

The study's main goal was:

1. To know and investigate the effect of continuous positive airway pressure (CPAP) in decreasing the neonatal mortality rate.
2. To compare the number of admission in neonatal intensive care unit and mortality rate in 2013 to our retrospective data from 2011.
3. To find the main causes of death in a newborn baby in Slemani city.
4. To assess trends in diagnosis and management of different disease and problems of neonate.

The research was done among neonates delivered in maternity hospital, whose indication for admission accordingto their complain and diseases. Finding, what is the admission criteria and advantage as well as the effect of CPAP according to the cause. Also to find the percent of the low birth weight and the benefit of CPAP in these age groups. It was hoped that the findings of this research will lead to more informed guidelines, and result in improved recommendations for the diagnosis, management of neonatal disease, and to show the role of using CPAP in decreasing the mortality, morbidity and improved utilisation of existing treatment facilities in Slemani city.

Figure 1: Premature baby on treatment[5].

Since this study has been carried out in a city about which much of the international health community has little knowledge, it is important to outline some of the contexts concerning Slemani.

A.2 Slemani city

Slemani is the second largest city in the Kurdistan Region of Iraq. Slemani, which is also called in Arabic language Sulaymaniyah, is located in the northeast of Iraq bordered by Baranan Mountain in the south,the Goyija Range,Qaiwan Range, and the Azmer Range in the northeast, and the Tasluja district in the west. The city has a semi-arid weather with hot, dry summers and cool, wet winters. Slemani was the capital of the historic Kurdish territory of Baban from 1784-1850[6].

Figure 2: Slemani City[7].

Slemani was established by Ibrahim Pasha Baban on 14 November 1784 who named it after his father Sulaiman Pasha. Because it was regarded as the center of a strong Kurdish principality, Slemani has developed into a large city that has a population of more than 1,700,000 people. It is an important economic place for Kurdistan of Iraq and the cultural place for Sorani-speaking Kurds. It has been named cultural capital of Kurdistan region continuously since 1992[7,8].

Slemani Governorate comprises of eight towns, 76 districts and 1,520 villages.It is located between longitude (450-460) east of Greenwich to the latitude (350-360) north of the equator and it is about 853m above sea level. The total population of Slemani province is about 1,600,258 people; 659 000 of them live within the city[9].

Figure 3: Map of Middle East[10].

Slemani has thirty health centers and seven large hospitals (Slemani surgical teaching hospital, Slemani medical teaching hospital, Slemani pediatrics teaching hospital, Slemani obstetrics and gynecology teaching hospital, Shar Hospital, emergency hospital and Shorsh general hospital). There are two large newborn baby care units in

both the obstetrics and gynecology teaching hospital and thepediatrics teaching hospital.In addition there is newly opened neonatal care unit in Shar hospital which is not organized yet[4].

Since liberation from 1991, it has been administered by Kurdish authorities and regards as one of the regional capitals of the (KRG) Kurdistan Regional government. It is quickly becoming a tourist attraction for Iraqis and other Middle East inhabitant due to its relative prosperity, security and undeniable natural beauty[11.12].

Figure 4: Kurdistan-Iraq map[10].

Kurdistan of Iraq, a part of Slemani has three large cities. Dihok, in the top part of the region; Erbil(Hawler), which is the capital city of Kurdistan and lastly Kirkuk, which is an oil-rich town and also has a mixed population of Arab, Turkman, and Kurd which regard as the majority part[12].

A.3 Research outcome

The research outcomes for this project will be to make public recommendations which aim to decrease neonatal mortality rate and to apply CPAP on indicated cases, where possible, and to improve the early diagnosis and optimal management of a common and severe problem that associate with high mortality rate among Slemani newborns. The aim is to encourage future NICU preventive policies in a way which draws upon locally available resources, for the very limited resources in this context need to be taken into account.

The thesis is presented in four chapters, followed by references and appendices. This chapter gives an introduction to the topic and offers a brief overview of the content. A background to the Kurdistan region in Iraq and Slemani and the magnitude of neonatal mortality rate and its leadingcauses are provided before detailing the main goals and objectives.

A.4 Outline of the thesis

This dissertation presents the main findings and subsequent recommendations of the study investigating neonatal mortality rate and the principal cause of death in NICU in Slemani, Kurdistan-Iraq. The thesis is divided into four chapters.

Following this introduction, relevant contextual information and a review of the current literature, the second chapter presents detailed description of the research design and methodology,it includes ethical issues that have been given consideration. Results are described in chapter three. Finally, in the last chapter, there is a discussion of the results, recommendations and conclusion are made.

Introduction B

B.1 Literature Review and Background

There is few local data and research on the information about neonatal intensive care unit, to know the main cause of admission and how we apply the treatment and its effectiveness, what are the main cause of death, how can be treated or prevent these diseases so as to decline the admission rate of this high number of cases and when admitted to be treated in to lower mortality rate.

The knowledge about the rest of Iraq is the same like Kurdistan region and Slemani City, little information is known,less research is done to improve the overall health system and to make some changes in a manner to improve neonatal care. This is reflected by the bad and worse political situation that the Iraq has passed through the past history,going from one war to others,invading other countries,some don't believe that only in 20 years from 1982-2002 Iraq had 3 wars which last for more than 15 years.Nevertheless the internal war not stopped at all which lead to destroy the economic and educational infrastructure,make the health system in the list of worst in the world.Slemani is starting to grow and develop step by step since the former Saddam Hussein regime fall on 2003[11].

Now the city is rank number one according to the health system and quality of life; the number of hospitals and health system increase in number and quality of service, good drug control, and a decrease in below 5 years mortality rate especially infant and neonatal mortality rate[11].

For the purpose of this study, current global literature on neonatal mortality rate, leading cause of admission and effect of CPAP, diagnosis and management of different disease will be analyzed briefly. The literature review on this topic includes commentary on the clinical information on each disease and using of CPAP to treat them as a general, global situation, and especially what is known about it in the Middle-East will be examined in the belief that this may hold some relevance for Kurdistan. Nevertheless, important contextual background for Slemani is outlined in this chapter.

B.2 Clinical information about neonatal mortality rate and CPAP

Neonatal period is the most risky period of life because of various diseases which a neonate faces. There are great overlaps between the risks associated with morbidity and mortality in the perinatal and neonatal periods. Neonatal mortality is a serious concern, both in the developing and developed worlds. While infant mortality rates have been decreasing gradually all over the world, changes in neonatal mortality have been much slower. Accurate documentation of fetal and newborn mortality enables investigations of change in perinatal death rates over time and assessment of their preventability. It is recommended that such an evaluation should occur both regionally and nationally[13].

A vast majority of newborn babies do not develop any serious problem or difficulties and require only minimal concern, which can be provided by the mother if appropriately supervised by a health worker staff. Mothers at high risk are likely to give birth to preterm or low birth weight babies who were go through from a large number of problems. However; the majority of the causes of neonatal morbidity are preventable[14].

High percentage newborns in developing countries exhibited an impaired growth during intrauterine life, reflecting the nutritional status of the mother. Within first 28 days of life about 42% of the infant deaths in our country occur. Premature baby accounts for the majority of high-risk newborns as they have a large number of problems[15].

Causes of neonatal deaths can be summarized into immaturity related including immaturity of many body organs, hyaline membrane disease or clinical respiratory distress syndrome in the absence of any other detectable etiology, congenital abnormalities including fatal chromosomal & physical abnormalities, birth asphyxia: which is happen when a normally formed term neonate is unable to start and sustain breath at birth or has low Apgar score, and infections like sepsis, pneumonia or meningitis[16].In Iraq urgent need to introduce health interventions to improve essential neonatal care and efficient treatment for neonatal conditions because deaths in neonatal period account for more than half of under-five children deaths[16].

Gregory et al.introduced CPAP into modern neonatology,as therapy in a significant number of infants with RDS and this soon replaced the more complicated ventilator therapy. Originally, regarded as a significant jump forward, CPAP was overtaken in the late 1970s by the development in ventilator technology joined with a wish to secure ‘cardio-respiratory control' using early mechanical ventilator with surfactant prophylaxis from the late 1980s. However, after 20 years , with the exception of a few ‘dissenting' centers in Scandinavia and the United States, early nasal CPAP has been experiencing a genuine renaissance in recent years [17,18].

CPAP has many pulmonary and systemic effects; CPAP increases the pressure inside the transpulmonary which results in a higher thoracic gas volume and functional residual capacity (FRC).It is thought that increasing the surface area for gas exchange and decreasing intrapulmonary shunt was due to increase in FRC which is caused by the recruitment of collapsed alveoli. Enhanced gas exchange after recruitment of alveoli with surfactant and CPAP can allow for lower FiO2 thereby reducing oxygen toxicity. Maintaining an adequate FRC as soon after delivery as possible will result in stabilization of air spaces, prevent the formation of atelectasis and encourage the release of surfactant stores[19].

The introduction of bubble-CPAP substantially reduced the need for mechanical ventilation,CPAP reduce mortality because of simplicity,shorter hospital stay and fewer complication.Bubble-CPAP may be regarded as the first type of ventilatory aid that is recommended in models of neonatal care for resource-limited countries. Its safety and low cost when administered by nurses makes it perfect for this purpose. Bubble-CPAP has the potential for being available at even lower cost than the current commercially available[20].

Continuous positive airway pressure (CPAP) is a type of respiratory support used in adult and pediatric patient's intensive care unit. In premature babies, when indicated CPAP is delivered through a set of nasal prongs or through a small mask that fits tightly over a baby's nose.Like nasal cannula, CPAP is used to deliver constant air pressure into a baby's nose, which helps the primitive alveolar unit in the lungs to remain open and helps prevent development of apnea. CPAP is often used in babies who are breathing well enough on their own that they do not need mechanical ventilation so it can deliver more pressure than nasal cannula, but who need more support than the cannula offers. CPAP can also be used to transport higher concentrations of oxygen to premature babies who have problem maintaining adequate oxygen levels in their blood[21].

CPAP decreases respiratory rate in children with respiratory distress compared with children not receiving CPAP. The technology was successfully used but some cases has mild to severe complications were associated with its use like air leak, pneumothorax,infection and gastric distention. CPAP is a relatively low-cost, low-technology that is a safe method to decrease respiratory rate in children with nonspecific respiratory distress[22].

Each year in children aged<5 years, respiratory failure and pneumonia account for about 1.3 million deaths[1].The global action plan for control and prevention of pneumonia focuses on a variety of interventions, such as exclusive breastfeeding for 6 months, improved hygiene, expanded childhood immunization, earlier diagnosis, and community facility case management[2].Advanced care in so many countries poses additional challenges. Given the limited ability for advanced pediatric care in many environments around the world, affordable, effective facility-based interventions likely will require considerable innovation[23].

B.3 Types of NICU

Well baby nursery offers care to healthy infants born near to their due dates. It provides regular medical care, including evaluation of vital sign, height, weight and head circumference in addition to the state-mandated newborn screening. They can typically worry about those premature babies born at 35 weeks if they do not have complications, and can preserve newborn baby born earlier than 35 weeks for transport to a neonatal intensive care unit[24].

Level 2 neonatal intensive care unit is a special care department which can give attention to newborn babies near to or greater than 32 weeks gestational age and for full-term babies who need close monitoring or IV antibiotics soon after delivery. This nursery can treat babies with some health problems of prematurity, such as jaundice and feeding distress or temperature control[24].

A level 3 neonatal intensive care unit provide intensive care for neonates born at all gestational ages. The definition of a level 3 NICU may vary in different states or hospitals, but all level 3 NICUs can care for babies born at more than 28 weeks, can provide respiratory support for babies who experience respiratory distress, and can deliver IV fluids to babies who cannot take milk feedings[24].

Level 3 is according to some classification systems, regarded as the top level of neonatal care, which can provide the same standard of attention as a level 4 NICU below[24].

An intensive care unit that can care for babies as young as 22 to 25 weeks gestational age called level 4 neonatal intensive care unit. It can provide sophisticated types of respiratory support like a mechanical ventilator, CPAP, and all the other services needed for very sick babies, and offer a wide variety of neonatal surgeries[24].

B.4 Neonatal mortality rate and CPAP in the world

Leading causes of infant death globally

In just ten countries two-thirds of the world's neonatal deaths occur, mostly in Asia. Number three among these countries is Pakistan. Annually with an estimated 298000 neonatal deaths and a recorded neonatal mortality rate of 49/1000 live births, Pakistan accounts 7% of neonatal deaths globally. Infection (36%), preterm birth (28%) and birth asphyxia (23%) account for 87% of neonatal deaths worldwide. Since etiology of neonatal mortality rate varies by country and with the availability and quality of health care, understanding neonatal death in relation to these factors is crucial. Data available on baby deaths in Pakistan come primarily from communities in which the cause of

death is rarely recorded or hospital studies, which have a selective referral bias. Information on pregnancy complications and other events before delivery is limited[25].

Among all deaths in children, deaths in the neonatal period (0–28 days) account for more than 1/3. Among neonatal deaths, 80% of all neonatal deaths are due to three main causes: low birth weight and prematurity (31%), neonatal infections (mainly sepsis and pneumonia and excluding diarrheal diseases) (26%) and birth asphyxia and birth trauma (23%)[26].

The leading cause of neonatal death in the USA in 2002 was:

1. Disorders related to short gestation and low birth weight was (24.2%).
2. Newborn affected by congenital malformations, and chromosomal abnormalities (congenital abnormalities) (21.2%).
3. Maternal complications of pregnancy(9%).
4. Newborn affected by complications of membranes, cord and placenta (5.4%).
5. Respiratory distress of newborn (4.7%).
6. Bacterial sepsis of newborn(3.8%).
7. Intrauterine hypoxia and birth asphyxia (2.9%).
8. Atelectasis (2%).
9. Newborn hemorrhage(2%).
10. Lastly birth trauma is the 10th leading cause of death in the neonate(1.8%).

In all, the 10 leading causes of infant death accounted for 77 percent of all infant deaths, the 23%is from other causes. From 2001 to 2002, the ranking of the most prevalent causes of neonatal death did not change[26].

The primary cause of death in Iraq, Al-Kadhymia Teaching Hospital was respiratory distress syndrome which constitutes (54.5%) of all the deaths, there are similar results which agree with our study that problems of preterm birth, respiratory distress syndrome, sepsis, lethal malformations, asphyxia were still the main causes of neonatal deaths and accounted for 95% of deaths[27].

RDS occur primarily in preterm infants, the incidence inversely related to gestational age and birth weight, it occurs in 60-80% of infants <28 weeks gestation, in15-30% of those between 32-34weeks, in nearly 5% after 37 weeks and rarely at term [28.]

The incidence of sepsis is 1-8/1000 live births, the mortality rate is high (13-25%), higher in premature and those with early fulminate disease. Infections accounted for 37% of all deaths [81,82].Infected in utero accounts for 2%, and up to 10% of infants are infected during delivery or the first month of life. The infant acquired the organisms in utero or postnatally.

The main direct causes of neonatal deaths at global level are infections including (sepsis/pneumonia, tetanus, and diarrhea, 35%), preterm birth (28%), and birth asphyxia (23%). There is geographical difference in specific etiology of death[29].

In 2009, an estimated 3.3 million neonates died during their first month of life, compared with 4.6 million neonates in 1990. About 41 % of all deaths of children under 5 occur in the first month (the neonatal period). Progress to reduce newborn mortality has been particularly slow in countries like Africa. Newborn deaths could be reduced by as much as a third with simple preventive measures, those taken within hospitals, including giving antibiotics and implementing resuscitation techniques, could reduce deaths by 2/3[30].

Statistics on exactly how many neonates are dying worldwide during their first month are missing. Currently, the United Nations collects annual reports on mortality rate of children under 1 year old, and under age 5 children, but not specifically on neonatal deaths[30].

Over the 20 years, the world wide neonatal mortality rate decreased, from 33.2 deaths per 1,000 live births to 23.9 deaths /1,000 births. Deaths of children between the ages of 3 and 5 and maternal deaths are going decreasing to 30 to 40% more quickly than neonatal deaths. The difference may be due in part to a lack of attention, funding and policy changes related to reducing neonatal deaths. Preterm delivery, asphyxia and severe infections are the three leading causes of newborn death; these are largely preventable with the right care[30].

By country

Over the last 20 years in the United States, the drop was less than the average drop - 26 percent. The United States dropped from number 28 to number 41 in the rankings of newborn mortality risk and is now close to Qatar, Croatia and United Arab Emirates.

One of the bigger challenges in the U.S. is complications from preterm birth. The U.S. rate of premature birth is increased to double that of countries in Europe and Northern Africa. Babies who are born preterm need extra management and care that is often costly. While there are few points that can reduce preterm birth, poor people in the United States may be less likely to get proper care for preterm infants[30].

Still, the neonataldeaths are much worse in the other countries. In Afghanistan, one in 19 neonates dies in the first four weeks of life (53 per 1,000 births). Half of the world's newborn deaths occur in five countries like: India, Nigeria, Pakistan, China and Democratic Republic of Congo. India has the highest rate of newborn deaths, with 900,000 per year[30].

If progress is not made to reduce the percentage of newborn mortality rate, the portion of child deaths that occur in the neonatal period is likely to increase in the future. It is essential that national governments, international agencies, and civil society increase attention to systematically prevent and track neonatal deaths.

As shown in table 1,main cause of neonatal mortality rate in USA is prematurity(42%),sepsis and pneumonia(18%),asphyxia (16%),congenital problem(15%),tetanus and diarrhea each with (1%) and other causes account for (7%)[30].

In Eastern Mediterranean, prematurity is ranked number 2 with (22%), but the number one cause of death is sepsis and pneumonia (29%), other cause of death comes in the same order like USA.Europe,is the same when the first cause of death is preterm baby(38%)and followed by Asphyxia(20%) then sepsis and pneumonia (18%),congenital problem(16%),tetanus and diarrhea (1%) each and other causes putted in the last of list with (6%).Western pacific region, preterm baby (32%), asphyxia (26%), sepsis and prematurity(21%)[30,31].

***Figure 5: Causes of neonatal death in the world.**

Region	**Cause of Death**	**Percentage**
USA	Preterm	42%
	Sepsis/Pneumonia	18%
	Asphyxia	16%
	Congenital Problem	15%
	Tetanus	1%
	Diarrhea	<1%
	Others	7%
EMR(Eastern Mediterranean Region)	Sepsis/pneumonia	29%
	Preterm	22%
	Asphyxia	20%
	Tetanus	12%

	Congenital	9%
	Diarrhea	4%
	Others	6%
Europe	Preterm	38%
	Asphyxia	20%
	Sepsis/pneumonia	18%
	Congenital	16%
	Tetanus	1%
	Diarrhea	1%
	Others	6%
WPR(western pacific region)	Preterm	32%
	Asphyxia	26%
	Sepsis/pneumonia	21%
	Congenital	8%
	Tetanus	3%
	Diarrhea	1%
	Others	8%

B.5 Neonatal mortality rate and CPAP in Middle East

Neonatal mortality rate (NMR) can define as the ratio of the number of deaths up to 28 days of life and the number of live deliveries occurring in the same population during the same period of time.

Despite of considerable efforts to increase the quality of primary health care, including antenatal, neonatal, perinatal care, and maternity services. In Jordan, the national neonatal mortality rate remains high at 15 neonatal deaths per 1,000 live births. While pregnant women have excellent access to care 98.6% deliver in hospitals; high

neonatal mortality suggests that deficiencies in the Jordanian health care system still exist[32].

Respiratory distress syndrome was the leading cause of death among newborns, accounting for (53%) of neonatal deaths, followed by sepsis (16.2%), congenital anomalies (13.8%) and asphyxia (10.1%) [33].

In Turkey the percentage of pregnant women making a minimum of four antenatal visits was around 80 %.The neonatal mortality rate was 26 in 1998, 17 in 2003, and 13 in 2008, significantly better in 2009 which decrease to 10/1,000.Most deaths were due to prematurity and its complications, making (47.2%) of (ENM) early neonatal mortality and (36.1%) of (LNM) late neonatal mortality[34].

In the first one, most common causes of death were congenital anomalies other than genetic and heart disorders (17.5%), congenital heart disease (4.0%), asphyxia (6.1%), and infections (6.5%), while in LNM, they were infections (19.9%), asphyxia (3.8%), congenital heart disease (7.7%), and congenital anomalies other than heart and genetic disorders (13.1%)[34].

Within eight years neonatal mortality in Turkey has declined to level close to that reached by Economic Co-operation and Development countries Organization in nearly 30 years. Our findings show that each of the leading causes of the neonatal death can be prevented by existing interventions. Efforts to prevent prematurity, early diagnosis of congenital anomalies and the prevention of infections would contribute to further reductions in neonatal mortality in Turkey[34].

The neonatal intensive care unit is a tertiary health center department of which provide specific therapeutic care for neonate that has any problem or complication and with this reason it seems that mortality rate might be more than other patient care department. It is of particular importance to the evaluation of health status of a country depending on tracking the trend of NICU's mortality rate [34].

In neonatal intensive care unit of Najmiyeh University Hospital, Tehran, Iran, in a cross-sectional study using the medical records data; to investigate the 10-year trend of mortality rate from the year 2001 and 2010. Over this periods 368, 470, 485, 884, 747, 520, 600, 720, 668 and 735 babies havebeen admitted to this unit and among them 25 (7%), 36 (8%), 56 (12%), 44 (5%),43 (6%), 49 (9%),40 (7%), 34 (5%), 32 (5%) and lastly 31 (4%) died, respectively. Regarding the therapeutic, technological and technical improvement, the mortality rate was decreased year by year. The death rate in this period was 6.2% [35].

Although the higher neonatal mortality rate(NMR) in neonatal intensive care unit was reported by another studies, infant mortality rate is recorded 3.18 in 1000 live births in Iran.International organizations such as United Nations Children's Fund (UNICEF) and World Health Organization (WHO) consider applicable principles essential for providing effective health services in hospitals and health centers[35].

On the other hand, birth of a premature baby and also staying in NICU is associated with separation of neonate from family and hospitalization which can burden a lot of stress to the parents. Nevertheless, many factors should be considered to understand the variation of mortality rate in neonatal care unit such as improvement of triage process, dropping the cost of procedure and in result increasing in availability and low-severity admissions varied between hospitals. Therefore, it is necessary to create a national standards recipe of nursing and medical care for NICUs in Iran[36].

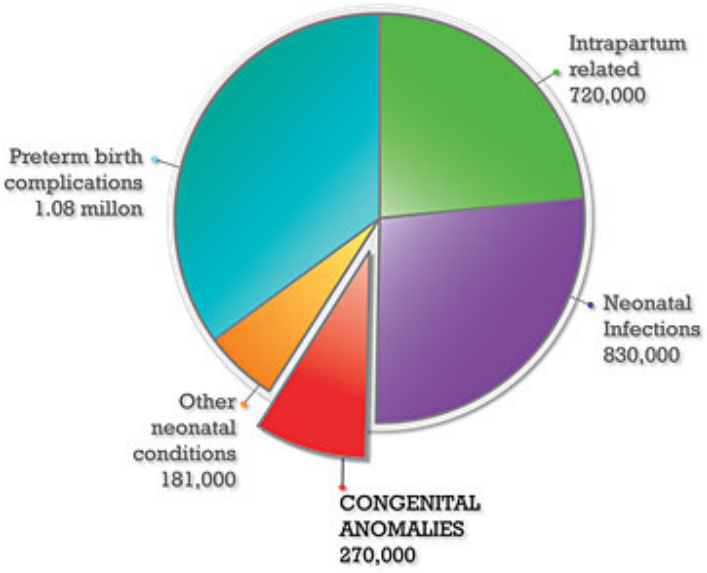
Millennium Development Goal 4(MDG 4), has been a focus on global health improvement strategies and plans of action since 1990.Neonatal mortality (NMR), being a component of childhood mortality. Therefore, the result is that global neonatal mortality has decreased to an estimated 3.1 million neonatal deaths per year reported in 2008 from an estimated 4 million neonatal deaths / year reported in 2005[37].Unfortunately, this decreasing in neonatal mortality has been uneven. The countries, which in demand to most improvement had the least gain; the main reason being financial, political, technical resource, and administrative restriction. Some countries, particularly Sri Lanka, Brazil, and the State of Qatar, have done exceptionally well by dropping down their neonatal mortality rate[37].

In Qatar during the last 36 years, there was a significant decline in both early and late neonatal mortality rates. However, the dropping was more significant in ENM rate than in LNM rate. This decreasing was during the period when formal tertiary care NICU was being started in Qatar. Hence, an increasing number of low birth weight babies and extremely preterm baby were resuscitated and provided intensive care unit. Simultaneous and parallel to this change, due to booming assisted reproductive technology, the country had seen an increasing number of preterm births. The outcome was an increase in early survival rate followed by delayed deaths of newborn babies born at the limits of viability. The similar model had happened in high-income countries during late 1980s and early 1990s[38].

One of the highest regions in the Middle East for under-five child mortality rate is Iraq; neonatal deaths accounted for more than 50% of under-five children deaths highlighting an vital and urgent need to introduce health interventions to progress essential neonatal care and treatment. Priority needs to be provided to the prevention of diseases, early as soon as possible and effective management of neonatal conditions, diarrheal diseases,

acute respiratory infections, and accidents. This study points to the need for further standardized assessments of under-5 mortality in Iraq[39].

Causes of 2.7 million neonatal deaths in 193 countries in 2010



Source: Adapted from WHO. Born too soon. The global action report on preterm birth. Geneva, World Health Organization, 2012

B.6 Causes of Neonatal death

Congenital anomaly

Congenital anomalies are also recognized as birth defects, congenital disorders or congenital abnormalities. It can be defined as structural or functional anomalies, including metabolic disorders, which are present at the time of birth[40].Pre- and peri-conceptional detection care includes basic reproductive health practices as well as medical genetic screening and analysis. Screening for neonate can be conducted during the following three periods:

•Preconception screening is used to identify people at risk for specific disorders or at risk for passing a disorder to their children. Obtaining family histories and carrier screening are two important issues and is particularly precious in countries where consanguineous marriage is common. It is better to give folic acid in low dose three months before pregnancy and in the first trimester[40].

•Antenatal screening includes advanced maternal age screening, carrier screening, rhesus blood group incompatibility, and selection for tobacco, alcohol, and other psychoactive substance use. Ultrasound can be used to identify Down syndrome during the first trimester of pregnancy and severe fetal abnormalities during the second trimester; maternal serum tests can also be used to screen for the discovery of Down syndrome and neural tube defects during the first and second trimesters[40].

Birth asphyxia

Birth asphyxia is defined as a delay in starting spontaneous respiration upon delivery of a newborn. It causes impaired gas exchange leading to progressive hypoxemia and hypercapnia with significant metabolic acidosis .It causes peripheral vasoconstriction, tissue hypoxia, acidosis, poor myocardial contractility, bradycardia and eventually cardiac arrest[41].

Birth asphyxia is a problem of all NICU global, especially in developing and poor countries. Recent estimates indicated that neonatal mortality rate had reached 4 million deaths worldwide with 23% of them due to birth asphyxia early after delivery. Up to 99% of these deaths occurred in those countries with low to middle income with bad neonatal service. Birth asphyxia, in the most severely affected babies, causes significant neuro-disability sequelae with high rates of mortality[41].

Meconium Aspiration

Meconium aspiration refers to fetal aspiration of meconium stained amniotic fluid (MSAF) during the antepartum or later in the intrapartum period.Meconium aspiration syndrome(MAS) refers to newborn respiratory distress secondary to the presence of meconium in the tracheobronchial airways or further distally in the alveoli; it may be further contaminated by blood and amniotic fluid[42].

MAS is a situation that occurs when a newborn infant aspirates (or breathes in) a mixture of meconium and amniotic fluid. Meconium is a newborn first bowel movement, which is thick and sticky, dark green and is usually passed the first few days after birth. For unknown reasons, the fetus will sometimes pass this first bowel movement while the infant is still in the uterus. During the birth process, the baby may breathe in or aspirate this meconium. This aspiration can happen hours before, during or immediately after delivery[42].

The aspirated meconium can partially or completely block the baby's airways, making it difficult for the baby to breathe and causing irritation of lung and infection. Further, meconium prevents the normal function of an important lung chemical called surfactant, which helps the lungs expand and function properly. The result of these meconium aspiration effects on the lung is a baby with mild, moderate to severe difficulty breathing and cyanosis[42].

The severity of the problem becomes depends first on the amount of meconium that aspirates, duration before delivery the meconium was aspirated and when the trouble is identified and treated.The chances of a baby passing meconium before delivery increases as the infant come near to his or her due date and markedly rises or increases after the due date. Although meconium in the amniotic fluid is not rare, occurring in 8–15% of neonates delivered at or near term, the vast majority of babies who pass meconium during labor and delivery do not get MAS[42].

Examples of conditions that may lead the baby to become stressed before labour include: A mother who is a heavy cigarette smoker or diabetes, high blood pressure or other medical condition, IUGR, prolonged or difficult delivery, postdate, complications with the umbilical cord or placenta and infection[42].

Infant of diabetic mother

Macrosomia and hypoglycemia of the neonate are the question mark that this baby may have a diabetic mother.It is defined as the birth weight of at least 4000 g. It increases the frequency of obstetric complications like asphyxia and cerebral hemorrhage in newborn, perineal tear, shoulder dystocia, or caesarian section and the risk of brachial plexus palsy [43].

Some risk factors for fetal macrosomia have been recognized; the strongest risk factors are a mother with diabetes, which results in a two folds increase in the incidence of macrosomia.Many of risk factors, like post maturity, obesity and multiparty, are highly prevalent among parturient [44].

In this circumstances the main investigation consist of blood glucose, echocardiography, electrolytes because insulin alters concentrations of many of them such as potassium, calcium, phosphate and magnesium, bilirubin, complete blood count (CBC) for polycythemia in the plethoric infant[45].

Transient tachypnea of newborns (TTN)

Is the most common reason of neonatal respiratory distress (RD) (>40%), followed by respiratory distress syndrome (RDS), and meconium aspiration syndrome (MAS). TTN is also identified as wet lung, RDS type II. It is relatively mild; self-limited disorder usually affects infant who is born at or near term. Typically, the infant becomes tachypneic directly after birth and has mild RDS[46].

Resolution usually occurs within 12-24 hours.The chest X-rays shows clear lung parenchyma with hyperinflation except for perihilar linear densities and sometimes fluid in the gaps. The treatment is generally close observation and symptomatic care[47].

B.7 Treatment of NICU patients

Prematurity and RDS

The most important preventive measure of RDS is prevention of premature birth by avoiding unnecessary or poorly timed caesarian section (C/S), appropriate treatment of high risk pregnancies and birth with intrauterine acceleration of pulmonary maturation by the use of antenatal steroid, and finally the immediate use of surfactant immediately after delivery of premature newborn baby [48].

The treatment of respiratory distress syndrome (RDS) requires monitoring of breath, heart rate (HR), partial pressure of oxygen in the blood (PaO2), partial pressure of carbon dioxide in the blood (PaCO2), bicarbonate (HCO3),serum electrolytes, blood Glucose, blood Pressure, supportive care is also needed for gentle handling, avoid chilling, and supplements of calories and fluid [49].

Preterm birth is the most important cause of neonatal mortality and the most common reason for antenatal hospitalization. In the United States, around 12% of all live births occur before term, and preterm labor preceded approximately 50% of these preterm births. The trouble with preterm delivery is clear; preterm births account for approximately 70% of neonatal mortality and 36% of infant mortality as well as 25–50% of cases of long-term neurologic impairment in children[50].

According to 2006 report from the Institute of Medicine estimated the annual fee of preterm birth in the United States (US) to be $26.2 billion or more than$51,000 per premature baby. However, identifying women who will give preterm birth is an inaccurate process. The reason of this document is to present the various methods proposed to manage preterm labor and to analyse the evidence for the roles of these methods in clinical practice[50].

The endogenous surfactant is a biochemical complex composed of neutral lipids, phospholipids, and proteins that form a layer between the terminal airways and alveolar surfaces and the alveolar gas. Surfactant deficiency is associated with the onset of respiratory distress syndrome (RDS), one of the leading causes of morbidity and mortality in premature infants. The surfactant is also valuable in treating infants with meconium aspiration syndrome (MAS), pneumonia, and pulmonary hemorrhage, although the evidence base for its used in these condition and disease processes is much weaker than the primary indication of RDS[51].

Surfactant improves lung compliance, by decreasing surface tension, and it maintains lung volumes at a lower transpulmonary pressure. Without surfactant, alveoli may collapse or may never inflate on expiration and require an excessive amount of force to re-expand on inspiration; Surfactant is traditionally administered by instilling through the endotracheal tube, injection through the nasopharynx during delivery can also be one way of its use effectively or by using a thin intracheally placed catheter. Experimental evidence confirmed and supports the delivery of some surfactants using a nebulizer[51].

Warmed, humidified oxygen should be sufficient to maintain PaO2 at 50-80 mmHg[52].Early using of continuous positive airway pressure (CPAP) may decrease the demand for mechanical ventilation, which may be needed when PaCo2 is more than 55 mmHg or rapidly increasing PaCo2 or PaO2 <50mmHg or severe, recurrent apnea[52].

Neonatal jaundice

Management options for hyperbilirubinemia consist of exchange transfusion and phototherapy. Exchange transfusion consists of replacing a portion of the newborn's blood with donor blood. This treatment has major morbidity and mortality and is generally reserved for the most severe cases of hyperbilirubinemia. Phototherapy with the light of wavelength from 430 to 490 nm spectrum is much safer than exchange transfusion, although it leads to expense and separation of mother and infant[53].

Since bilirubin levels commonly peak at 3 to 5 days of age, the AAP 2004 hyperbilirubinemia guideline recommends that most newborns be examined by a health care provider within 48 to 72 hours after discharge[54].Potential reasons for the protective effect of Cesarian delivery include the greater initial length of stay, leading to increased recognition and treatment of jaundice during the birth hospitalization, early formula supplementation, less placental transfusion, and stress before delivery prompting induction of conjugating enzymes or metabolism of bilirubin as an antioxidant[55,84].

Sepsis

Treatment of sepsis is most often started before a particular causative agent is identified. It consists of penicillin (usually ampicillin) plus an aminoglycoside [56].Treatment for most of the blood stream infections should be continued from (7-10) days or for at least (5-7) days after a clinical and physical response had occurred. The mortality rate from neonatal sepsis ranges from 10 and 40% (mean 20%) and has not dropped down for many years, serious morbidity can also be seen and long term sequelae like hearing problem and deafness, developmental delay and seizure disorders are seen in 40-80% of survivors following neonatal meningitis [57].

A good results depends on early diagnosis, and effective strategies to prevent sepsis must be included for example proper antibiotics initiation, cautious insertion and handling of central venous catheters; programs to increase emphasis on hand-washing compliance; minimizing central venous catheter duration.Maternal factors increase the risk of infection 3-4 fold, while prematurity and LBW increase the risk 20-fold [58].

Apnea

All premature babies transferred to the premature nursery were monitored continuously for HR, RR and O2 saturation Babies more than 2000 g were also similarly monitored when symptomatic and admitted to the newborn unit[59]. Apnea was recorded by the medical staff nurse or the junior resident doctor working in the Nursery. All data was analyzed for the incidence, cause, need for ventilation and outcome of neonates with apnea. The management administered included vestibular stimulation with rocking bed, aminophylline and ventilation whenever indicated[60].

Pneumonia

There are no published randomized treatment trials of neonatal pneumonia and few for neonatal sepsis in developing countries. Empirical management decisions must, therefore, be based on local resistance patterns and money costs, availability of various antibiotic regimens and benefits. There are also some informative trials using contemporaneous non-randomized control groups or retrospective in communities and hospitals in developing countries[61].

For the treatment of neonatal sepsis, WHO recommends giving ampicillin (50 mg/kg) twice daily from the first week of life latter every eight hours per day from 2–4 weeks, plus a single daily dose of gentamicin.First line alternatives to ampicillin if not available are benzylpenicillin or amoxicillin, and alternatives to gentamicin are streptomycin or kanamycin. Where staphylococcal infection is suspected, which mean where these are available (skin pustules, umbilical cord infection, cellulitis, pneumatoceles, or empyema), cloxacillin or flucloxacillin, should be substituted for ampicillin[62].Apnoea is a common complication of neonatal pneumonia, occurring in 28–43% of cases and respiratory failure unresponsive to oxygen invariably precedes a fatal outcome[63].

Training village health workers to recognize the clinical signs of neonatal pneumonia has been shown to reduce pneumonia mortality in several projects in remote areas. Using oxygen, on the basis of objective evidence of hypoxemia, has the potential for substantial reductions in neonatal and child mortality. A variety of methods are present for delivering oxygen, especially cylinders of compressed gas and oxygen concentrators. Oxygen cylinders are costly and heavy to transport, but can be used anywhere. Concentrators of oxygen are more cost effective in places remote from oxygen supply systems but require a continuous power supply. In rural hospitals in developing countries, they depend on a system of using concentrators with a cylinder as a backup when a power failure is common may be optimal[64].

Many neonates with severe pneumonia will be unable to feed well in the acute stage of the illness and require nasogastric or intravenous fluids[66.]Antibiotic administration after preterm rupture of membranes is associated with a delay in delivery and a reduction in major markers of neonatal morbidity (use of oxygen therapy, neonatal infection, and abnormal cerebral ultrasound scans). Encouraging management and referral of mothers with preterm rupture of membranes would reduce the number of babies born with intrauterine and early onset pneumonia[67].

Early and exclusive breastfeeding has been shown to decrease the risk of pneumonia in infants outside the neonatal period, and there are many reasons to expect a similar or greater protective effect against late onset neonatal pneumonia[68].

Programs to prevent and treat syphilis, chlamydia, toxoplasmosis and HIV would substantially progress neonatal outcomes and decrease much of the neonatal respiratory disease caused by these infections[69].

In Malawi in a non-randomized controlled trial, cleansing the birth canal at every vaginal examination with 0.25% chlorhexidine before delivery was associated with a lower rate of admissions in NICU for neonatal sepsis, lower mortality rate from infectious causes and lower overall neonatal mortality rate, and lower postpartum infection of the mother, than when no cleansing was done[70].

Two large randomized trials have shown that vitamin A supplementation at birth reduces young infant mortality. Giving treatment like 24 000 IU vitamin A on day 1 and day 2 of life in India resulted in a 22% decreasing in total mortality at six months of age[71].

Congenital Anomalies

In countries with well-established health services, many anatomical birth defects can be corrected with pediatric surgery and early management can be administered to children with sickle cell disorders, congenital hypothyroidism, and functional problems like thalassemia(inherited recessive blood disorders) [72].

Meconium Aspiration

If the baby is assumed of meconium aspiration but generally appears well, the health care team may simply monitor the baby for symptoms such as increased respiratory rate, grunting or cyanosis.

However, if an infant has aspirated meconium and appears ill, the first priority is to guarantee the baby is well oxygenated by supplying enough oxygen and supporting his breathing. Furthermore, treatments may contain:

• Breathing support by nasal cannula, CPAP or mechanical ventilation.

• Fluid and Nutrition by an intravenous catheter line (IV).

• IV drugs like antibiotics.

• Obtaining blood like arterial blood gas analysis (ABG) routinely to assess the baby's oxygenation and ventilation[42].

Infant of diabetic mother

High rates of macrosomia,hypoglycemia, hyperbilirubinemia, congenital anomalies and prematurity were reported. The mode of delivery and prematurity significantly affect the death of IDM. Better perinatal care and follow up of diabetic mothers and their newborn babies with tighter and better preconceptional blood sugar control is likely to reduce the prevalence of reported complications and death and improve the outcome for IDM[43].

Women with gestational diabetes may be managed successfully with glyburide, which may not cross the placenta and has no effect on the baby. In these mothers, there is no change and the incidence of neonatal hypoglycemia and macrosomia was similar to that in mothers with insulin treated gestational diabetes[44].

Macrosomia makes the infant of a diabetic mother at major risk for birth trauma due to cephalopelvic difference and obstructed labor. Not surprisingly, caesarian section delivery rates remain higher in infants of diabetic mothers with large birth weight as estimated from the ultrasound. Indeed, many complications to be anticipated with the provision of a child from a mother with diabetes, the presence of an obstetric team is highly suggested.

In the asymptomatic infant bolus injections of hypertonic glucose should not be used because they may lead to further hyperinsulinemia and potentially rebound hypoglycemia.In addition to a complete, thorough physical examination is essential to look for and find congenital anomalies cases. Although clinical suspicion for anomalies should be high, testing of all infants of diabetic mothers for diagnosis of congenital anomalies via imaging modalities are not currently standard practise[45].

Transient tachypnea of the newborn

Transient tachypnea of the newborn consequences from delayed clearance of lung fluid and is a common reason for admission to full term and late preterm infants to neonatal intensive care units. The state is particularly common after elective caesarian section. Conventional therapy involves supplemental oxygen, withholding enteral feeds and administration of intravenous fluids and antibiotics. Rarely, infants require CPAP and mechanical ventilation .Occasionally some babies grow severe hypoxemia and may require high concentrations of oxygen. The most efficient strategy for accelerating reabsorption of fetal lung fluid is exogenous glucocorticoids. Therapies for TTN should be based on an understanding of the physiology of normal fetal lung fluid clearance at birth. Racemic epinephrine, furosemide, and inhaled β-agonists have been analyzed for possible benefit in TTN. The routine administration of these drugs cannot be recommended unless additional data become available[73].

B.8 Effect of CPAP on treating problem in the NICU

Physiological Effects of CPAP on the baby

Continuous positive airway pressure (CPAP) has significant effect to increase arterial oxygen content. The mechanisms by which this is achieved are complex and probably due to a combination of the factors outlined below[74]:

1. Increases functional residual capacity (FRC).
2. Reducing the ventilation: perfusion mismatch which causes reduction of the right to left shunting.
3. Decreases airway resistance by increasing pharyngeal cross-sectional area.
4. Reduces obstructive apneas.
5. Stabilises the respiratory rate.
6. Reduces the severity of central apnea.
7. Protective effect of surfactant.
8. Decreases alveolar edema.

The consequence of CPAP works on lung mechanics to progress oxygenation (PO2) [74]. The effect on carbon dioxide (CO2) elimination is only secondary to the first process of improvement in lung volume and minute ventilation .CPAP maintains inspiratory and expiratory pressures more than or above ambient pressure, which should result in a rising in functional residual capacity (FRC) and improvement in static lung compliance and decreased airway resistance in a baby with unstable lung mechanics[74]. This allows a bigger volume change per unit of pressure change (i.e. greater tidal volume for a given pressure change) with subsequent decreasing in the work of breathing and stabilization of minute ventilation (VE) [74].The beneficial physiologic effects of CPAP are made by:

• An increased pressure transpulmonary resulting in an increased functional residual capacity and potentially decrease oxygen needs.

• Unstable chest wall stabilization effort.

•Lung compliance improvement (causes redistribution of fluid in the lungs).

• Decrease airway resistance.

• Reduces effort for breathing.

• Improvement in ventilation/perfusion ratios.

• May expand upper airway structures preventing upper airway obstruction and collapse.

• Preserves endogenous surfactant. Maintenance of optimal functional residual capacity improves surfactant synthesis and release[74].

CPAP increase in residual functional capacity by recruiting atelectatic alveoli thereby increasing the surface area for gas exchange and thus improves oxygenation[74].Application of CPAP stretches the lungs and pleura resulting in stimulation of stretch receptors. This has a beneficial effect on mixed and central apnea. Alveolar collapse results in a greater consumption of surfactant owing to decrease surface area, and CPAP could conserve surfactant by prevention of collapse and obstruction or enhancement of surfactant release through a cholinergic mechanism. This may explain why CPAP is of significant effect when used as soon as possible in the course of the disease while main of alveoli are open. Early application of CPAP is seen to decrease the need for mechanical ventilation.CPAP levels beyond 8 cm of water should be used cautiously in preterm babies. With high CPAP levels, a decrease in tidal volume occurs resulting in hypercarbia and hypoxemia. A decline in CPAP level at this point would lead to an improvement of ventilation[75].

Figure 6: CPAP machine[76].

Sequence of side effects in CPAP therapy:

Tachycardia or increase in heart rate → increased capillary filling time → Fall in blood pressure → decreased urine output → Acidosis (metabolic). Blood PCO2 may initially drop down, but may rise subsequently over a period due to gas trapping[77].

Renal System: it can result in a decrease in glomerular filtration rate and thus decrease urine output. Effect on renal is directly proportional to compliance of the chest wall. Decreased renal blood flow results in increased aldosterone and ADH secretion[77].

Central Nervous System

With the application of CPAP, there is an increase in intracranial pressure (ICP). This, in combination with a decrease in arterial pressure, results in falling in cerebral perfusion pressure (CPP). Rising in ICP is seen more with head box CPAP than with endotracheal or nasal prongs CPAP. In low birth weight neonates ventilated for RDS high ICP is instrumental in the pathogenesis of intraventricular hemorrhage. Head box CPAP is not used currently[78].

With the current CPAP devices and protocols, this finding in clinical practice is not evidenced.It is evident that when CPAP pressure is more than 6 cm of H2O and mainly when the pressure is nears 8 cm of H2O, the significant rising of central venous pressure coincides with the decreases in PaO2 levels and increased PaCO2 levels.

Contra-Indications to CPAP

1. Congenital abnormalities e.g. a diaphragmatic hernia, choanal atresia, tracheo oesophageal fistula, frontal encephalocele
2. Nasal trauma/severe damage that might be exacerbated by the use of nasal prongs.
3. Cardiovascular instability is a relative contra-indication as these infants may be better preserved by intubation and ventilation.
4. Frequent apnea and bradycardia were not responding to treatment with CPAP and caffeine.
5. Gastro-intestinal perforation[74].

Adverse Effects

1. Air leaks (pneumothorax.)

In preterm infants with RDS the use of CPAP is associated with benefits concerning reduced respiratory failure and reduced mortality, but an increased rate of pneumothorax[84]. There is a risk of pneumothorax in all babies requiring ventilation or positive pressure; however, the incidence is highest in babies < 1000g. Prophylactic or early surfactant reduces this risk 47.48.Air leaks may occur due to the disease process (alveolar overdistension with CPAP), particularly when the lungs are improving and lung compliance is increasing. Clinical signs of air leak include increasing respiratory distress, oxygen desaturation, decreased air entry and asymmetrical chest movement[77].

2. Gastric dilatation (abdominal distension):

As the continuous distending pressure is applied to the nose, the delivered gas can enter the stomach and GI tract. "CPAP belly" is a well-recognized phenomenon that can be reduced by the insertion of an orogastric tube (≥6 G) on free drainage. It is relatively uncommon but there is a risk of aspiration, further respiratory compromise and visceral rupture [77].

3. Overdistension of the lung.

Over distension by the use of high pressures can cause poor oxygenation and carbon dioxide retention. Cardiac output may also be reduced secondary to impeded venous return[77].

4. Nasal Irritation.

The fixation devices can cause irritation, damage or necrosis to the nasal septum or skin. The area should be inspected regularly to avert these complications. Over-tightening of the strapping can also result in irritation and necrosis to the nasal septum [77].

5. Obstruction of the prongs

Obstruction of the prongs by secretions or other means will stop delivery of continuous distending pressure to the lungs and airways. The pressure will be maintained by the obstruction. Humidification of gases and selective, gentle suction of the airways are important strategies to prevent this problem [77].

Stability Criteria

• On ≤5cm H2O nCPAP (mouth closed)

• Oxygen requirement less than 25% and not increasing (FiO2 ≤0.25)

• Respiratory rate less than 60 cycles per minutes

• No significant chest recession

• Less than three episodes of apnea, bradycardia, desaturations (<80% for more than 20 seconds) in 1 hour for the previous 12 hour period

• Average saturation >86% most of the time or PaO2/transcutaneous PaO2> 45mmHg

• Not currently treated for PDA or sepsis[77].

Failure criteria (at least 2 of the following)

• The intercostal recession and use of accessory muscles, with respiratory rate >75 cycle per minutes

• Increased apnea and/or bradycardia and/or desaturations >2 in 1 hour for the previous 6 hour period

• Increased FiO2 requirement >25% to maintain oxygen saturations >86% and/or PaO2/transcutaneous PaO2 >45mmHg

• pH<7.2 • PaCO2/transcutaneous PaCO2>65mmHg . Apnea or bradycardia requiring resuscitation[77].

Chapter Two: Study Design

The study was cross-sectional, collecting prospective data of neonatal mortality rate and its main causes of death below 28 days in Slemani city during 2013 and comparing it to the retrospective data of 2011. A quantitative approach was used to analyse the data. Data collection was through the administration of a questionnaire to the patient's guardians and key informants provided pre-existing data on the prevalence and management of neonatal problems in NICU, the effect and role of CPAP in decreasing the neonatal mortality rate.

2.1 Methodology

2.1.1 Setting

In Slemani city, two main hospitals are dealing with neonatal problems and diseases. The neonatal intensive care unit in the paediatric teaching hospital, and the neonatal care unit in the obstetric and gynaecological teaching hospital; there is newly opened neonatal intensive care unit in Shar hospital but still not as good as the previous two. There are no other centers in the surrounding region. Over the last five years it has been estimated that in summer nearly 90-100 patients weekly were admitted in the paediatric teaching hospital but in winter approximately 60-70 neonates were admitted to the same hospital.

This study was conducted at the neonatal care units in obstetric and gynaecological teaching hospital in Slemani city because they serve nearly all parts of the population of Slemani. Women in this around come to this hospital for delivery and taking advice for their babies from the first seconds of their lives, including those mothers from rural areas that have been referred to this hospital.

2.1.2 Population

The population consisted of all neonates below 30 days of age who were patients in this main hospital in Slemani city. The obstetric and gynaecological teaching hospital is one of the biggest hospitals in Slemani city which deals with pregnant women and delivers either normal vaginal delivery or caesarian section. All babies delivered in this hospital were fully assessed before going outside the hospital and any infant with any health problems like respiratory distress syndrome, prematurity, infant of a diabetic mother, pneumonia, congenital anomaly, asphyxia, sepsis or any other problems must admit here and treated accordingly.

Babies presenting at this hospital between 1st of January 2013 and 31st of December 2013 who had one medical problem indicated for using CPAP constituted the sample.

Key informants were paediatricians, administrators, and key hospital staff working at this hospital.They were requested to provide recording data in the form of the hospital mortality data, hospital deliveries, and other relevant documentation about the neonatal intensive care unit cases and their treatment.This all done so as to determine the effect of CPAP in decreasing the neonatal mortality rate.

2.1.3 Population Size

Within the 12 months from 1st January to 31st December 2013, a prospective hospital-based data collection was conducted. The number of patients diagnosed with one of the neonatal diseases indicated for using CPAP was 156. The total number of babies born at the obstetric and gynaecological teaching hospital during this period was 9510.

2.1.4 Monitoring and sampling

I have used two methods of data collection. One form was based on the retrospective data that was found in the Health Governorate, especially data from 2011, and focusing on the diagnosis, and management of neonatal diseases, the number of admissions as well as the rate of death.

The other method of data gathering was a questionnaire consisting of 52 questions (see Appendix 2) prepared for this research. As a substantial number of parents were illiterate, the survey was administered by an interviewer. In this research, the junior doctors working in the neonatal intensive care unit did the interviewing. Questions were translated at the time of questioning and each answer was written down. Questions were in the simple language and featured both open-ended and close-ended forms.

All babies delivered in this hospital by normal vaginal delivery will be checked after resuscitation in delivery room corner and after recording the vital sign, also the babies delivered by caesarian section will be checked and if indicated will be admitted to the neonatal intensive care unit.Main problems that show for admission are prematurity, infant of diabetic mother, meconium aspiration syndrome, congenital heart disease, congenital malformation, congenital pneumonia, sepsis, prolonger rupture of membranes, oligohydramnios, polyhydramnios, twin babies, hydrops, and floppy neonate.

Admitted neonates will be put on the monitor and all the vital sign will be recorded. Also the height and weight and head circumference; those cases with respiratory distress syndrome, Apnea, meconium aspiration syndrome, pneumonia, sepsis will put under the CPAP; we have only nasal prong so most of them will be on the nasal prong CPAP.

Regarding the use of antibiotic, we use for all the neonates ampicillin and gentamycin to prevent bacterial infections for 3-5 days and for other mentioned diseases we use antibiotics accordingly and depending on culture and sensitivity of blood and the result of complete blood count or C-reactive protein.

When we receive a preterm baby(<37 weeks), we resuscitate accordingly and weight the baby and will divide to LBW(low birth weight), VLBW (very low birth weight), and ELBW(extremely low birth weight).The vital sign was taken (RR, HR, temperature, PO2, BP)which is respiratory rate, heart rate, oxygen saturation, blood pressure,respectively. If we suspect RDS (respiratory distress syndrome), pneumonia or chest-heart problem, we will send the case to take CXR (chest X-ray), and taking a blood sample for complete blood picture and CRP(C-reactive protein).

We will give surfactant to those cases between 25-33 weeks, to manage the primary leading cause of death which is respiratory distress syndrome. It's of great value to put the neonate under the CPAP if indicated, most of the cases stayed for 2- 5 days and getting better.But there are few cases have complications of CPAP like the air leak, pneumothorax, infection.

Basic demographic data were collected at the start of the interview to put the respondents at ease. The research questionnaire was used in this hospital and the junior doctors working there completed the forms according to the cases and the parents’ responses.

2.2 Data Analysis

Quantitative Data

Quantitative data was the main type of data collected in this research. The questionnaire was used to survey sample of 156 patients. Because in the main, the data generated was of a quantitative nature, it was analyzed using normal calculating system and SPSS to see if the result is statistically significant .This software was used to perform a basic descriptive analysis, providing information about frequencies and means in the forms of tables, charts, and graphs. Demographic data and responses that were quantifiable were analyzed.

2.3 Ethical Considerations

2.3.1 Potential Research Value

Information gained from this study will form the basis for future guideline in diagnosis and treatment of NICU cases, to know the main cause of death among newborn babies, categorizing the number and percentage of death and its main leading risks, how the CPAP will decrease the mortality rate. This research will open the window for the upcoming and future research in this city and region where little about it known.

2.3.2 Approval and Informed Consent

Prior to the commencement of the study, ethical clearance was obtained fromthe Health Governorate in Slemani city.

Dr. Mhamad Dlshad is the deputy administers of the Slemani Health Governorate and has overseen this project. He ensured that rotator doctor approached the families of all patients in NICU whose under CPAP and that information was provided about the research, as well as ensuring consent to collect clinical information as per the questionnaire was obtained. Both the information sheet and consent form were translated into Kurdish and read to the families by these doctors.

The questionnaire was coded for each patient and the list of patients and their codes were kept separate from the questionnaires. If a patient was seriously ill, the family was not to be approached and, instead, the (RMO) Resident Medical Officer endeavored to complete as much of the questionnaire as possible from the patient clinical record. Fortunately, in all cases, requests were accepted and nearly all questions answered.

Every participant family (the neonate's parents) was informed in their language about the study's objectives and methods, allowing a clear picture of what to expect from participating in the project. Written or oral consent was obtained from all participants, and they were informed about their right to refuse to participate. The issue of confidentiality was addressed before consenting as well, assuring the infant's parents that no personal details would be released.

2.3.3 Limitations of this Research

This research took place in Slemani city, which had a noticeable proportion of death among newborns. It is worth noting many limitations encountered in this research:

1. Insufficient historical clinical information:

Due to the history of war, and strikes on Slemani city and the Kurdistan region generally, there is a deficiency in available clinical information. Saddam's regime, over the last 30 years, resulted in several major wars with the Islam Republic of Iran, the invasion of Kuwait, the war with the Peshmerga, and lastly the battle with the American coalition. Since 2003 and after fall of this regime, because of the central problem and due to lack of good medical and health research centre which impacted on the capacity for medical and academic authorities to resource appropriate records, research and scholarship.

2. Few Number of CPAP machines

Kurdistan of Iraq regarded as one of the developing countries, although it regards as the best region in Iraq and some country, that's why there is few, only four machines of CPAP were available and were newly bought to the center. The number of CPAP was insufficient to the high number of premature babies admitted and to other indicated cases of highly demand to the CPAP.

3. Warranty of CPAP

The company that provides these CPAP machines had problem in services and maintenance of the machines because sometimes these machines were not working in a proper way and the company delayed in responding to our request to solve these problems.

4. Accessories of CPAP were few and the process for providing these accessories was very hard and need six months to purchase them by our health directorate, which by this affect our work and sometimes we obliged to reuse them.

5. Insufficient trained medical staff to work on the CPAP and to clean them in the proper way, as mentioned there is only three medical staff for nearly 15-25 cases. According to the British association of perinatal medicine, it should be one nurse to one patient 1:1 in NICU,1:2 in special care unit[87].

6. It was hard to do work when the patient was on CPAP,for e.g. taking chest X-ray, taking a blood sample and sometimes feeding of the babies, because we have to call their families to come and assist us.

7. Some cases need and indicated for the CPAP, but because of few number of it is available, so they left without CPAP and therefore not included in this study.

Chapter Three: Result

This chapter presents the research findings, which include both the description of the clinical experience and trends of diagnosis and management of neonatal intensive care unit cases of different diseases and the application of CPAP to decrease mortality rate in newborn babies in Slemani. The social, demographic and clinical profiles of the sample of 156 neonates and their families from the prospective aspect of the study conducted between January first-2013 to December 31- 2013 also presented.

3.1 Trends in diagnosis and management of NICU cases in Slemani City:

NICU of maternity hospital consists of 25 beds, 18 of them provided with central oxygen and air, the remaining beds is without the oxygen and air. There are 20 incubators and 15 cots, also the unit provided with 20 monitors and central monitor is there located in the staff room. There are 4 CPAP machine and 1 portable ultrasound. 24 nurses working in three shift of 8 hours in this unit , this unit also have 4 rotator doctor, 4 senior house officer and four pediatricians working in this unit ,every day there is one pediatrician interested in NICU,one senior house officer and one junior doctor and monthly they changed[79].

Everyday 20-25 cases admitted in the maternity NICU,for example January/2013 (830 cases),Feb 2013(1010 cases),March/2013(797 cases),April /2013(676cases), May/2013(434 cases),July/2013(662 cases),June(871 cases),August(795 cases),September(982 cases),October(816 cases),November(801 cases),December(836 cases) [79].See chart 1 below:

Slemani still is in top cities among other cities in Iraq according to the below five years children and infant mortality rate, according to the report of Iraq ministry of health Slemani has the lowest number of below five years mortality rate [79].See chart 2 below; Slemani has 55 death per 1000 live birth which is la lowest among all other cities.

Main cause of admission was prematurity and respiratory distress syndrome, pneumonia, neonatal jaundice, meconium aspiration, infant of diabetic mothers, congenital anomaly, and surgical disorders. The number of admission increased, because there is a strategy to admit all cases that's a product of cesarean section, which make a load on the unit .The number of admission increased in 2013 in comparison to 2011.Data are given in table 2 below:

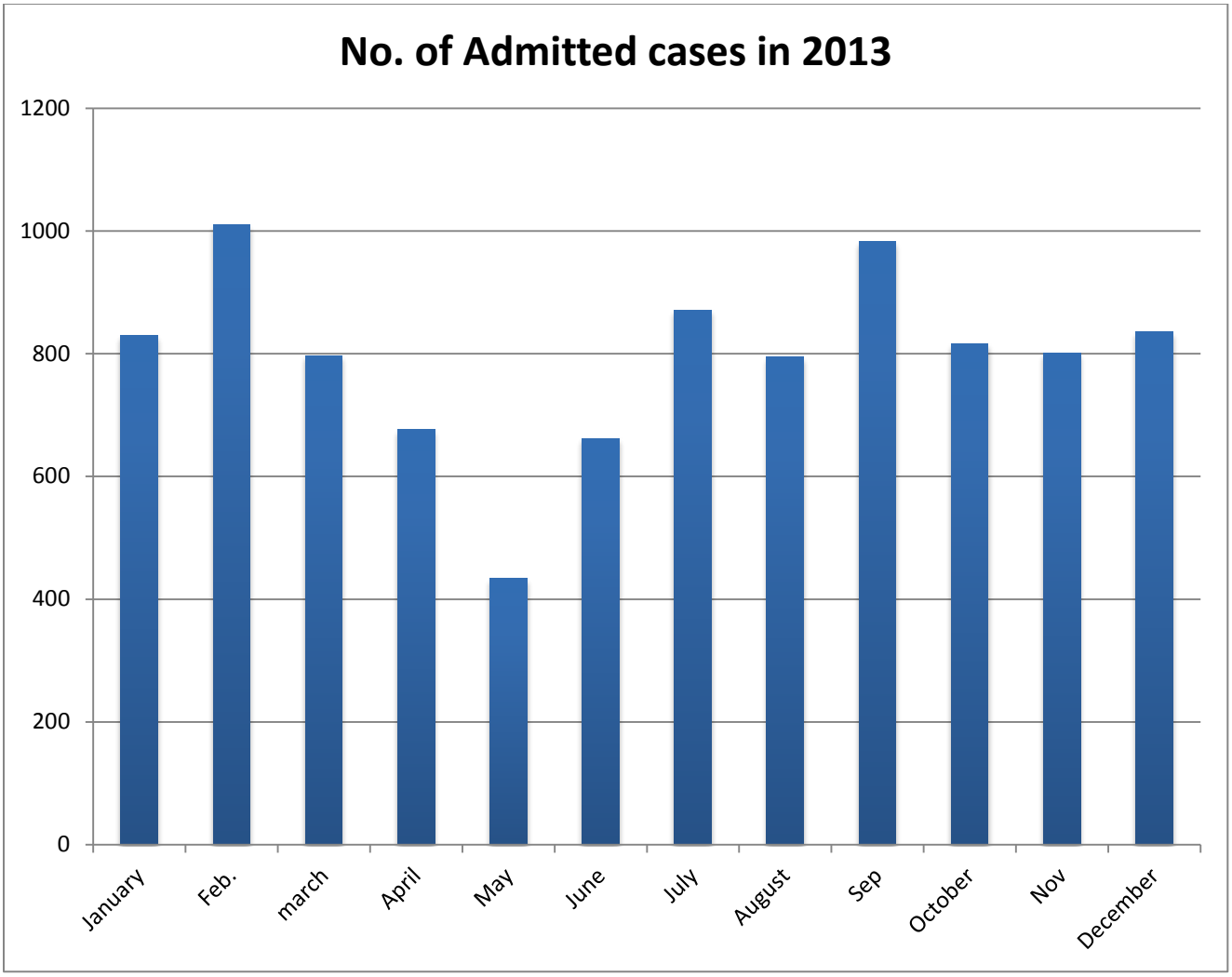
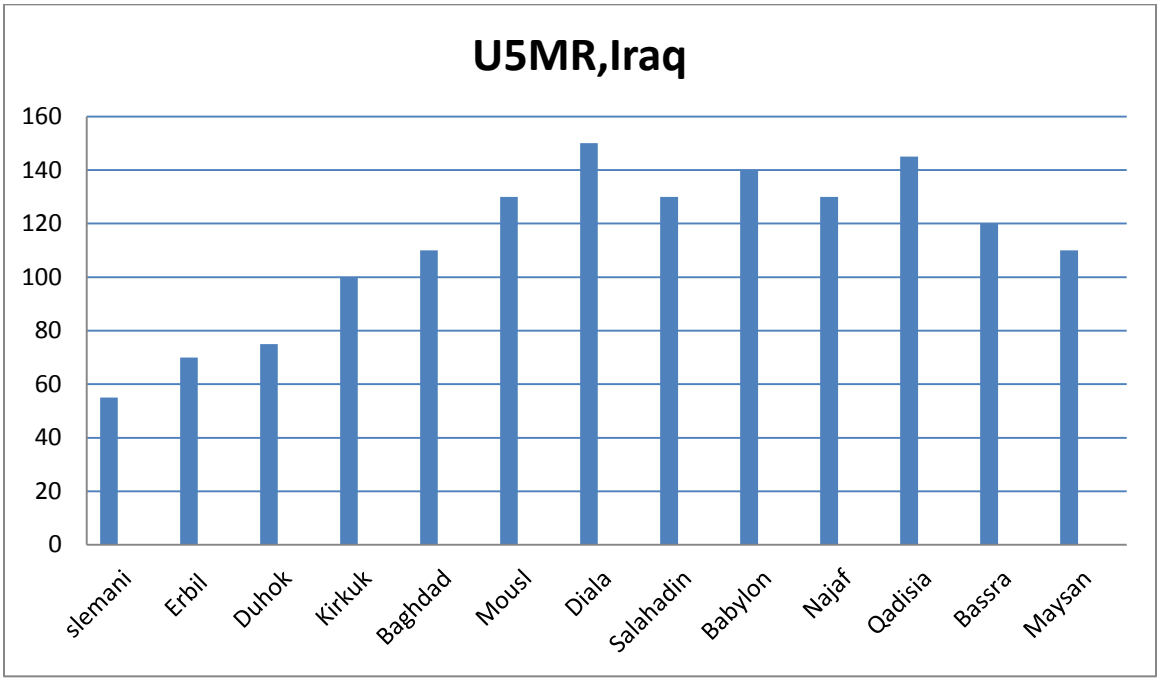


Chart 1: Number of admitted cases in maternity neonatal care unit in 2013

**** Table1: Number of admitted cases in both 2011 and 2013 in Maternity Hospital NICU.**

Year	***No. Of Admission***
2011	**7937**
2013	**9510**

Chart 2: Under five years mortality rate in Iraq,1999.



When premature labor develops and cannot be stopped, the health care team will prepare for a high-risk birth. The mother may be moved to a center that is set up to care for premature infants in a neonatal intensive care unit (NICU).

After birth, the baby is admitted to a high-risk nursery. The infant is placed under a warmer or in a clear, heated box called an incubator, which controls the air temperature. Monitoring machines track the baby's breathing, heart rate, and level of oxygen saturation or partial pressure of oxygen in the blood.

A premature infant's organs are not fully developed. The infant needs special care in a nursery until the organs have developed enough to keep the baby alive without medical support. This may take weeks to months[83].

Infants usually cannot coordinate sucking and swallowing before 34 weeks gestation. A premature baby may have a small, soft feeding tube placed through the nose or mouth into the stomach. In very premature or sick infants, nutrition may be given through a vein until the baby is stable enough to receive all nutrition through the stomach.

Prematurity used to be a major cause of infant deaths. Improved medical and nursing techniques have increased the survival of premature infants.

In maternity NICU when the baby delivered, there is a nurse in the delivery room, but if it born in the operation room and by cesarean section the receiving person will be the junior or senior house officer in addition to the nurse. After the resuscitation, the newborn baby will transfer to our neonatal care unit and accordingly we treat the cases, but the transporting of a child is in a bad way, the nurse will pass the patient through the window which is present in between the delivery room and the neonatal care unit.

We will give antibiotic to most of premature baby if C-reactive protein (CRP) is positive or in the indicated cases, we will not allow feeding for tired cases or those below 2 kg,so we will give intravenous fluid and put them in incubator to prevent heat loss and prefer warm place, further any case develop RDS(respiratory distress syndrome),pneumonia, apnea or any other condition indicated for CPAP we will put under it.The duration of CPAP is different according to the severity of the condition and the response to the usual treatment; nearly between 2-5 days. Because we have limited space we can keep the premature baby for 15-20 days and accordingly we discharge them on follow up basis, sometimes if the case is stable we prefer early discharge to have a space for new cases because of high load of cases on our unit[85].

Pneumonia is another common indication of admission in Maternity NICU,main cause of it is either from meconium aspiration or milk aspiration and bacterial cause which is mainly due to group B streptococcus, Escherichia coli,other gram negative or staphylococcus pneumonia, haemophilus influenzae.In this unit our line of management is to record the vital sign and to take chest x ray,to see any radiological change, to do infectious screen like complete blood pictures,c-reactive protein, blood culture and sensitivity.Accordingly we will give antibiotic to cover gram positive and negative organism which is best to give ampicillin and gentamycin;if the distress is sever its wise to put the baby under CPAP for few days till become better[80].

There is no exact data on Slemani city, but according to the World Bank report that done in nearly all Iraq, they regard it as number one among all other Iraqi cities according to health, sanitary system, hospital management and below five years mortality rate[86].

3.2 Prospective study

3.2.1 Socio – demographic profile

In the period in question, 156 babies were diagnosed with indicated diseases to put under CPAP. This sample of diagnosed babies consisted of 88 (56.4%) male and 68 (43.6%) female cases. Consanguinity or intermarriage was present in 41% of cases. Of these cases, most of the infants 79(51%) lived in the urban region, while the other 77 (49%) lived in rural areas. All of them were Muslim. (See: Table 2).

Table 2: Socio-demographic Profile

Socio-demographic category		Number (N=156)	Percentage %
Sex	Male	88	56.4%
	Female	68	43.6%
Consanguinity	Yes	64	41%
	No	92	59%
Location of life	Urban	79	51%
	Rural	77	49%

Table 3: Age of mothers that gave birth during this period of study

Mother Age	Number of cases	Percentage
< 25 Years Old	33	21.2%
25 – 35 Years old	78	50%
➢ 35 years old	45	28.8%

3.2.2 Clinical profile and assessment

There are 2 news to be heard, one is bad news which is the number of admitted cases increased in 2013 (9510 cases) in comparison to 2011(7937 cases);but the good news is the decrease of neonatal mortality rate from 236 cases in 2011 to 223 cases in 2013,however the admission rate increased, which means it is statistically significance because the p-value is less than the common alpha (0.05),and the good step toward a better administration and better guideline in treating the cases and major role for CPAP in decreasing the neonatal mortality rate are given in table 4:

Table 4: Number of admission and mortality rate in maternity Hospital in 2 different years 2011 and 2013

Year	***No. Of Admission***	***No. Of Death***	***Neonatal mortality rate***	***Comment***
2011	**7937**	**236**	***3%***	
2013	**9510**	**223**	**2%**	
T- Test	**23.2**	**P- Value**	**0.037**	

Birth weight of the newborn baby plays a very important role in decreasing the mortality rate and to tolerate the diseases and have a better outcome, the condition is proportional; the lesser the baby's weight the higher the mortality rate, the lesser the weight the higher the stay in hospital and more expenditure will be pay out .

In this study among 156 cases 49 (31.5%)were less than 1.5 kg,97 cases(62.1%)were between 1.5-2.5kg and the other 10 cases(6.4) were more than 2.5kg.The highest mortality rate 14(9%)were in the first group whose is less than 1.5 kilogram, and the lowest1(0.6%) in the third group whose more than 2.5kg.For details see table 5.

Table 5:Weight of newborn baby put under CPAP and number of death among them(percentage of total newborn on CPAP)

Weight	**Number of cases**	**Percentage**	**Number of death**	**Percentage death overall**
< 1.5 kg	49	31.5%	14	9%
1.5 – 2.5 kg	97	62.1%	11	7%
➢ 2.5 kg	10	6.4%	1	0.6%
ALL	156	100%	26	16.6%

The weeks of gestation also has a great role in determining the rate of death, the lesser the weight of newborn baby the longer the stay in hospital and the more vulnerability to suffer from infection and complication of prematurity,which in the end lead to higher mortality rate.

In our study of 156 cases, those below 32 weeks of gestation was (107cases)(68.7%)have higher mortality rate (22cases)(14.1%),and those more than 37 week(11cases)(7%) have lesser mortality rate(1case)(0.6%).See below table 6

Table 6:Gestational age of newborn baby put under CPAP and number of death among them

Gestational Age	Number of cases	percentage	Number of death	Percentage
Equal or <32 W	107	68.7 %	22	14.1%
33 – 36 W	38	24.3 %	3	1.9%
➢ More 37 W	11	7 %	1	0.6%
ALL	156		26	16.6%

Worldwide,mainly in developing countries there is an enhancement toward the normal vaginal delivery and decreasing the bad thought in women's mind whose think about the caesarian section as an easy mode of delivery; because the latter one carry a higher rate of risk especially due to anesthesia. In the (table 7) unfortunately there is a higher rate of caesarian section C/S (90 cases)(57%)when comparing to normal vaginal delivery(66cases)(43%).

Table 7: Mode of delivery of the cases

All cases	C/S	NVD
156	90 (57 %)	66 (43%)

Antenatal corticosteroids have its effect for fetal lung maturation, decrease neonatal death, infection and interventricular hemorrhage. The steroid regimen consists of administration to the mother of two doses of 12mg betamethasone in single dose intramuscular, 24 hours apart. In this research unfortunately only 30cases (19.2%) received antenatal corticosteroid; most of those taking the steroid were below 35 week and lesser than 3.2 kg and 123 cases (78.8%) not used it, this is due to urgent presentation of these women to the Maternity emergency department and inability to stop labor contraction or delivery for any reason or may be attributable to bad health system that not follow these women in their place of rural or country side. For details see table 8.

Table 8: Number of cases receiving antenatal corticosteroids

Used antenatal corticosteroids	**Not used**	**Not specified**	**Total**
30 (19.2%)	123 (78.8%)	3 (2%)	156

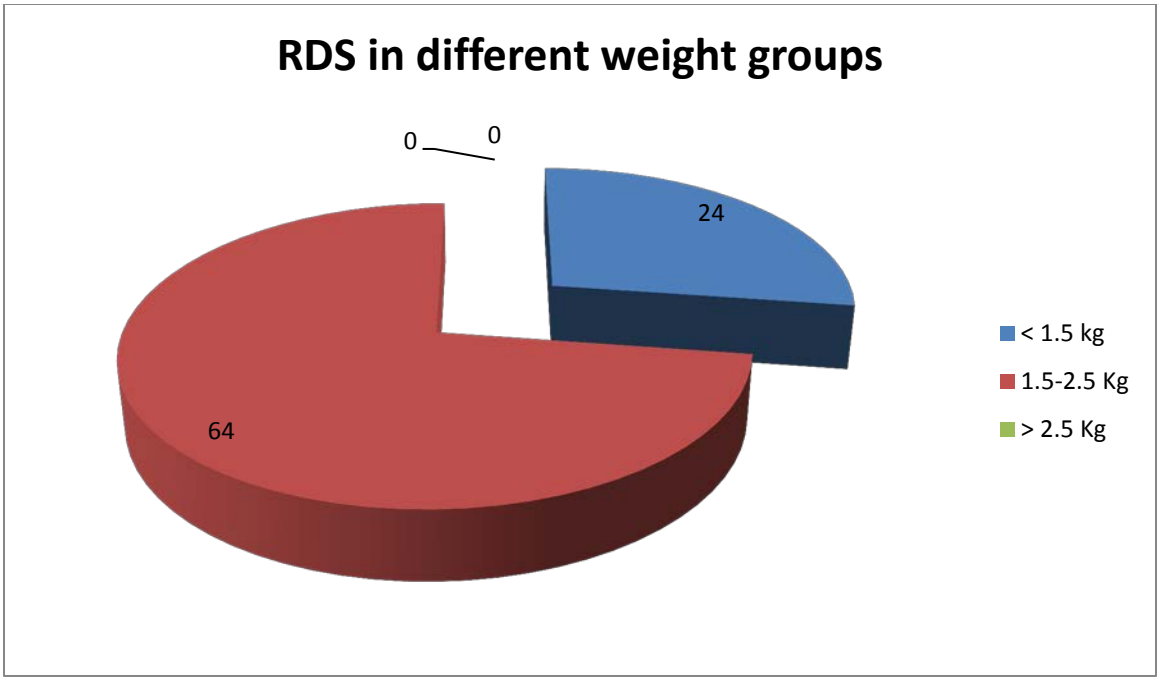
CPAP has a great role in decreasing the mortality rate of the NICU cases and its indication is nearly the same around the world.The main indication is prematurity and its complication like respiratory distress syndrome, apnea and infection like pneumonia,meconium aspiration,nosocomial infection,TTN(transient tachypnea of newborn),and birth asphyxia are another cause of CPAP application. Table 9 gives the main indication of CPAP application in Slemani maternity hospital neonatal intensive care unit.

Table 9:Indications of CPAP in Slemani maternity hospital NICU

Indication	Number	Percentage
RDS	88	56%
Apnea	24	15%
Congenital Pneumonia	13	8%
Birth Asphyxia	12	7.5%
Nosocromial Sepsis	11	7%
TTN	5	3%
Congenital Sepsis	5	3%
MAS	4	2.5%
T E Fistula	1	0.6%
Nosocomic Pneumonia	1	0.6%

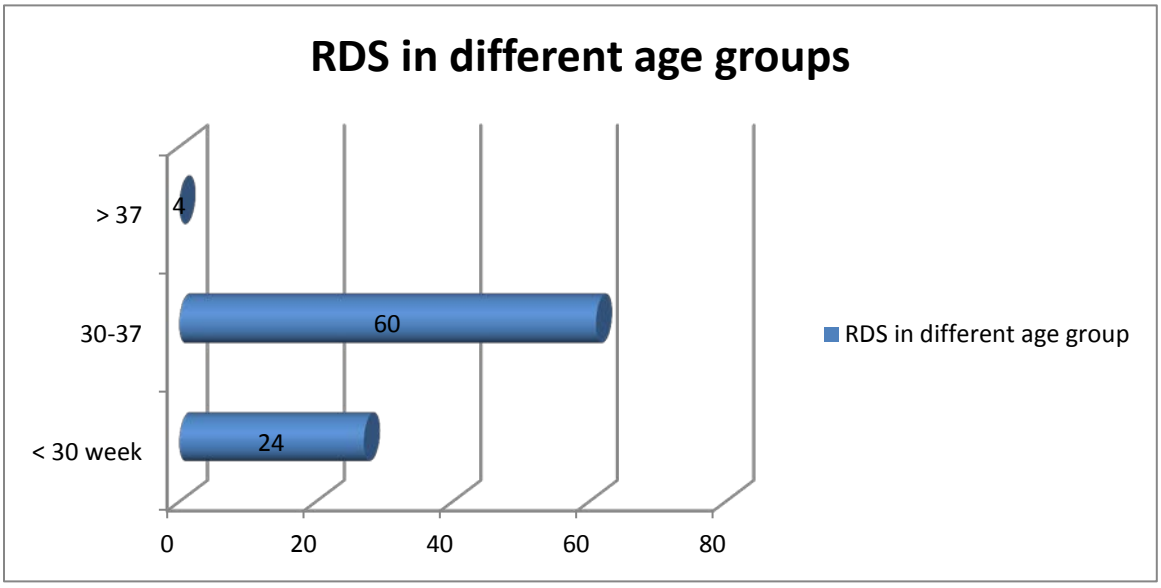
The total number of respiratory distress syndrome (RDS) was 88 cases, which was the main indication for using CPAP in our hospital. The great rate was in the weight group between 1.5-2.5 kg (60 cases)followed by less than 1.5 kg (24 cases) and lastly patients more than 2.5 kg are four patients. Data are given in chart three below:

Chart 3: RDS in different weight groups



The total number of respiratory distress syndrome (RDS) was 88 cases, which was the main indication for using CPAP in our hospital. The great rate was in the age group between 30-37 weeks (61 cases)followed by less than 30 weeks (27 cases) and lastly patients more than 37 weeks are four patients. Data are given in chart four below:

Chart 4: RDS in different gestational age groups



As given in table 10, the usage of surfactant in our research was unfortunately used for only 97 cases and 33 cases not used it and there is unavailable data to the other 26 cases. This is because of high cost of this drug which costs 300 US $, that make it difficult to be available in hospital for use all the time.

Table 10: Using of Surfactant among the cases

Used Surfactant	Not used	Un available	All
97	33	26	156

There are many complications of CPAP,which vary from pneumothorax,due to air leak,seizure and intra cranial hemorrhage (see table 11). 6 cases has pneumothorax,4 has seizures and 2 cases has intracranial hemorrhage.Unfortunately we cannot follow the cases on CPAP to see the complications for all patients,because we do CXR, cranial ultrasound and other measures according to the patient's condition. In the other hand the retrospective data from 2011 shows few complications which cannot be compared with 2013 data.

Table 11: Complications of CPAP among the cases

Complication	Number	Percentage
Pneumothorax	6	3.8 %
Seizures	4	2.6 %
Intracranial Hemorrhage	2	1.3 %

The main causes of death in a newborn baby in Slemani city is depending on the number of mortality in it's two main NICU department of both hospitals.In my study, I have found the main causes of newborn baby death in NICU of Maternity hospital.Number of death was 26 cases in total, among them 13 (50 %) cases was passed away due to prematurity and it's complications like respiratory distress syndrome, apnea, and others.The second leading cause was an infection like sepsis and pneumonia which account for 7 cases (26.9 %), asphyxia regarded as the third leading causes 3(11.5 %), meconium aspiration syndrome(MAS) was (2 7.6 %)cases and lastly one case (3.8 %) of pneumothorax. For details see table 12

Table 12: Main causes of death in Slemani Maternity Hospital NICU.

Cause of death	Number	Percentage
Preterm	13	50 %
Sepsis/pneumonia	7	26.9 %
Asphyxia	3	11.5 %
MAS	2	7.6 %
Pneumothorax	1	3.8 %
Total	26	100 %

Some cases deteriorated on CPAP so we thought about pneumothorax, CXR took and showed it. As we see in chart number four; pneumothorax has the same rate in the age group below and above 30 weeks.

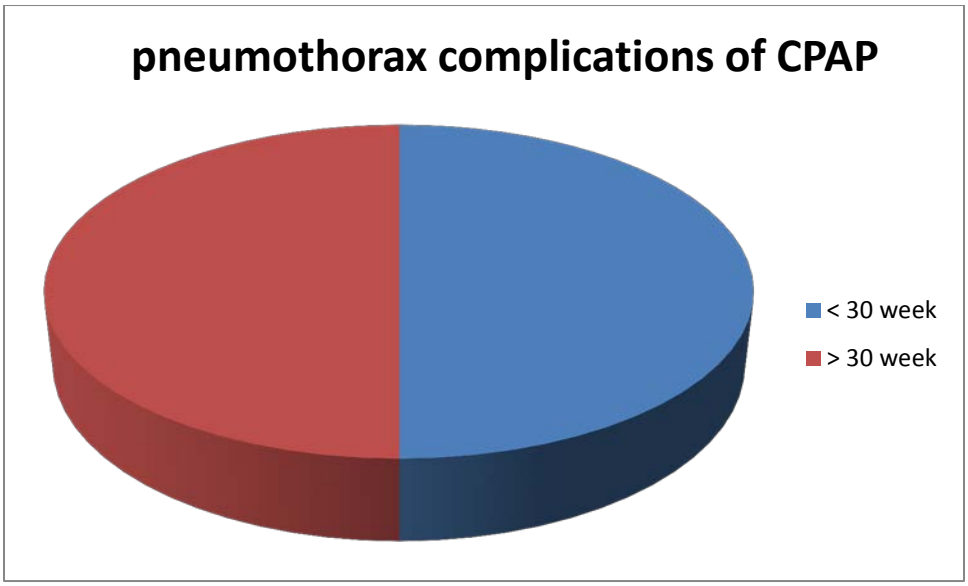


Chart 5: pneumothorax in different weight group

Chapter Four: Discussion and Conclusion

4.1 Introduction

This chapter discusses the main themes which emerged from the study and the research limitations. Further analysis of emerging topics and implications for future research or interventions arising are also presented. The chapter closes with recommendations resulting from this study.

4.2 Discussion

Slemani City has two main neonatal intensive care units (NICU).The first one is located in the maternity hospital and consists of 20 beds dealing with neonates after delivery presenting with threatening problems or diseases. The second neonatal intensive care unit is in the paediatric child health teaching hospital, which consists of 25 beds and treating those cases from inside Slemani and the surrounding places outside this city. This situation is scientifically not accepted, because there should be at least ten neonatal care units like this and nearly 2-3 neonatal intensive care units to cover up to 100 cases. The countryside should also provide by a mechanical ventilator,enough CPAP devices and the total parenteral nutrition in addition to the common equipment and enough trained staff to deal with each case in a usual way.

This high number of prematurity which is the first cause or main indication of using CPAP 88 (56%) and apnea24 (15%) is the same as many countries around the world.The main cause of prematurity in this center is because of its location in the maternity hospital, infections like prolong rupture of membranes, polyhydramnios, oligohydramnios, pregnancy induced hypertension or diabetes, early marriage or multiple pregnancies and previous caesarian section.

In a great center, handling of premature babies is crucial and it is started from the first second after delivery till the neonate passed his or her 37 weeks of the age.In our center, the management of premature baby is good, but there are problems in three main aspects or parts of treatment which are actually regarded as three crucial aspects or “golden hour” of the premature baby; these problems are in the receiving of baby after delivery which usually be in the resuscitation corner in both operation room or delivery room and must stabilize the case after drying, warming, cleaning and to do what’s needed accordingly, then after 20-30 minutes the baby should transfer in a specially coat or incubator called transporter to the intensive care unit.

However, in our center, there is no sufficient number of staff, and they have so many cases that make them unable to do their work efficiently. Thus, they send some cases of low birth weight around 1-1.5 kg back to their parent's house. Sometimes due to high number of delivery the nurse will send the neonate before stabilizing them just by hand and through a window which is present between the delivery room and the neonatal care unit to us. Therefore the neonate may not receive oxygen for 20-30 seconds and further may be hypoxic hypothermic.

The second aspect of proper treatment is in NICU facing standards in European countries when high-risk cases are admitted, they will do most available management. Thus, after checking of the cases and recording all the information on computer, there is a team of consultant physicians, specialized neonatologists and well-trained staff dealing with each case. They will put under oxygen blender and see if need more than 40% of oxygen then they give surfactant and put them under CPAP.If necessary, the baby took a second and third dose of surfactant in the first 24 hours. After all these treatments if the case need,the neonate put under the ventilator and eventually given total parenteral nutrition(TPN).In our NICU, unfortunately, there are not enough CPAP only four CPAP for nearly 20 cases and there is no maintenance for this equipment. Also, there are no mechanical ventilators and no TPN.

Third part of “golden hour” is keeping the patient in neonatal care unit up to 37 weeks of gestational age because sometimes you observe new problems like apnea, surgical problems like late presenting diaphragmatic hernia, aspiration pneumonia, and to make the preterm baby grow. Adequate temperature control and ability to suck the milk, further is necessary in our unit because of this vast number of cases admitted each day there is no space to all patient so just if the neonate can breathe without oxygen and after 3-5 days of management we discharge the baby, later those cases may be readmitted in other NICU of pediatric teaching hospital.

Corticosteroids play a great role in decreasing respiratory distress syndrome and should be used before labor to those pregnant mother at risk of delivering a premature baby, given in 2 separate doses each with 24 hours apart; in the maternity hospital of Slemani because of those high number of pregnant women visiting them which is more than usual and many of them are from the countryside without a planned program, many of them have n regular check-up of their pregnancy. There may be no time to give the steroids and due to their emergency situation. The baby still will be delivered without receiving steroids and by this the risk of newborn baby intratrachela RDS is high.

Surfactant also has o major effect by decreasing the complications associated with prematurity and meconium aspiration. Most of the very premature babies need this material and it may be used twice times in first 24 hour; however it may not be used in our center as necessary, not due to different ideas regarding its importance but due to high costs of the drug and a large number of cases which would need surfactant. In our unit we do not have oxygen blender to detect the percentage in which surfactant is indicated rather we depend on the clinical assessment of newborn babies like respiratory refractions and tachypnea also vital sign monitoring especially hypoxia and CXR show the characteristic ground grass appearance, we correlate all these findings to give surfactant and later to put them on the CPAP.

In most countries in the world, there are programs for pregnant women starting from diagnosis of pregnancy till the delivery. In our city, this program is right and in each health center, there is a booklet for pregnant women to have it and be followed monthly to monitor the blood pressure, blood glucose, weight and other vital signs and give them advice on the requirement of food and education about the pregnancy and breastfeeding. The main problem is that the women especially uneducated social class or those from countryside do not have the possibility to go there regularly.

Congenital pneumonia constitute 13(8%) of indicated cases and it's due to bacterial infection which may be ascending from the mother or may be acquired in the neonatal intensive care unit. By taking chest X-ray (CXR), complete blood count (CBC) and C-reactive protein (CRP) they can be diagnosed and then they go on CPAP plus giving proper management of antibiotics. In general, there are great responses and good treatment results within few days.

Birth asphyxia which is another indication constitute 12(7.5%) of total cases, which is due to difficulty during delivery of the baby and insufficient oxygen delivery to the brain which cause cerebral hypoxia, those cases get benefit from CPAP and decrease their stay in NICU by stabilizing respiration.

The main problem which was faced during this research was the unavailability of enough CPAP devices in the unit because only 4 were available and because of technical issues some of them did not work in a proper way. Overall there were other cases with need for CPAP, but unfortunately it was unavailable. Another problem is the way the cases were followed during their treatment and their stay in NICU, due to the limited number of medical staff which is only one specialized doctor, one senior house officer physician and one rotator doctor for 24 hours besides to 3 nurses in each shift for nearly 20 cases.

Those cases under CPAP need many controls and sometimes require retaking of CXR.The need of permission of the parents and availability of one of them to assist in taking the CXR for the reason of X-ray exposure risk, it's taking a long time, sometimes more than 1 day is needed for that because of long distance of their family from the hospital.

The location in which people live may play a role in this research. Those cases whose their family is from rural area is minimally less with 77 (49%) than from the urban area 79(51%); however this may carry a high risk of infection because of bad control of the health program of mothers and a high number of consanguinity and multiparity, which overall leads to more cases with prematurity and low birth weight and increased risk of infections.

In the district and countryside which is nearly 1-2 hour away by car from Slemani,like Chamchamal, Kalar, Ranya and Qaldza there is no neonatal care unit and if at any time facing a problem with the baby it is sent directly to Slemani city and many times the parents of these babies bring it by themselves and not by ambulance to the city .Thus often when we see the neonate, they are hypoxic and hypothermic this makes the condition more serious.

A number of deaths was 26 (16.6%), those with <1.5 kg in14 cases (9%),1.5-2.5kg birth weight in 11 cases(7%) and more than 2.5 kg in only 1 case(0.6%).The main causes of death were prematurity with RDS, infection like sepsis,pneumonia and necrotizing enterocolitis.When comparing retrospective data especially for admission and mortality rate with the recent data, we see great effect of decreasing the mortality rate when using CPAP.

** see table 4 + 5+12

Although we have mentioned this problem in order to find a way to make changes and do something for a better health system and good neonatal health system.We have to not forget that Slemani city is still in the top and best city in regards to the health system and lower neonatal and below five years mortality in comparison to whole Iraq.

*** please see chart 2 page 50*

4.3 Recommendations

It should be acknowledged that at the conclusion of this research there will be issues that warrant further investigation. Based on the information obtained, the following recommendations are made to further improve NICU conditions and manage neonatal diseases and problems in better way in Slemani:

1. If possible and health resources permit, it is far better to identify groups at high risk of developing RDS, apnea, pneumonia, MAS, infection and diabetic mothers by prenatal care.

2. Encouraging all families, especially rural families, to go to health center regularly and to take the advice carefully also to go to the hospital for delivery and to not ask for C/S.

3. Most problems and diseases in the newborn babies require early diagnosis, careful control, prompt treatment and follow-up to prevent further complications.

4. CPAP and ventilator should be available in our NICU and if needed for all new cases requiring ventilator support and experienced staff for regular maintenance and care.

5. Each bed or 2 beds should have availability of CPAP and ventilator, especially for premature babies.
****PLS see 2.3.3 number2**

6. Readmission due to early discharge accounts for high number NICU cases. It is therefore preferable to keep babies for as much time as needed in the neonatal care unit before discharge, even if they are not diagnosed early with RDS or other disorders to prevent readmission or severe late complications.

7. Number of medical staff should be increased to a level for instance one nurse for every 1-2 cases, and to be trained well.
****PLS see 2.3.3,NO .5 page 48**

7. New NICU should be opened because in the city of Slemani of nearly 2,000,000 people only 2 NICU of 40 beds available.

8. Giving attention and care to the district surrounding Slemani city, and opening NICU there because a high number of cases coming from these district and it need 1-2 hour till they reach the city and this may affect the outcome of the treatment and may lead to death or problem like hypoxia, acidosis and coma.

9. Antenatal corticosteroid injection of 2 doses prior to delivery is a very important point to decrease RDS,so providing more and more information about it in health centers and through the mass media will play a major role in decreasing the neonatal mortality rate. In our study only 19.2% of cases have a chance to use the steroids.

10. Only 97 cases from a total of 156 received surfactant, some of them with doubtful indications, a large portion was put on CPAP and did not receive surfactant because of unavailability. We recommend surfactant to be available for all cases with an indication and to be used more than once in first 24 hours if indicated.

11. A resuscitation corner in each delivery room or operation room should be fully equipped and with enough trained medical staff to do the best for the neonate and not sending the neonate until to be stable for transfer to the NICU.

12. Transporting of the neonate from delivery room or operation room must be done by a special incubator and provided by monitors and oxygen.

4.4 Conclusion

This research investigated NICU casesand disease in Maternity main hospitals in Slemani, Kurdistan, to know the effect of CPAP in decreasing the mortality rate in this unit. Further, it outlined forms of treatment and identified deficiencies in NICU cases treatment in order to improve the neonatal health care in general and to decrease the cases of death or complicated newborn. The need to concentrate on high risk groups especially has been emphasized. The research provides an understanding of the perception, experience and responses of NICU babies and their families. In addition, the findings of the study may provide useful and practical information to policy makers and other researchers wishing to improve intervention and implementation initiatives for improving neonatal outcome by reducing mortality and morbidity.

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Appendices

Appendix 1

Patient Information Sheet

Dear Parent,

Neonatal mortality rate is increasing and has high percentage in our city in comparism to the world but fortunately lower than other part of Iraq,and if it's not treated early and properly especially by using CPAP or ventilator many neonate pass in early days of life. We undertake this study so as to find main causes of neonatal mortality rate and to determine improved prevention in Slemani city. This will benefit everyone whose kids suffer from any disease or problem in NICU.

In order to be able to understand the problem we need to gather data first. we collect data by asking you a few question .The interview will take approximately 5-10 minutes .You will not need to take part in any kind of experiment ,if you do not wish to take part in this study or want to discontinue at any time, you are free to do so. The data is treated confidentially.

Your cooperation is highly appreciated.

If you have any questions regarding the study or its outcome, please fell free to contact:

Dr.Soran Jamal Taher

Pediatrician

Ph: 07702229922

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Appendix 2

Questionnaire Paper

Data collection record

Hospital: _____

Inclusion criteria fulfilled?	□ yes	□ no
Present of any exclusion criteria?	□ yes	□ no

1. Peri- and neonatal characteristics / demographic data

Patient-ID	
1.1 Gestational age	__ __ + __ weeks □ not specified
1.2 Time of birth	__ __:__ __
1.3 Birth weight	__ __ __ __ gram □ not specified
1.4 Length	__ __ . __ cm □ not specified
1.5 Head circumference	__ __ . __ cm □ not specified
1.6 Gender	□ male □ female □ not specified
1.7 Multiple birth infant	□ yes □ no □ not specified
1.8 If yes: number of infant	□ infant 1 □ infant 2 □ infant 3 □ not specified
1.9 1-min Apgar score	__ __ □ not specified

1.10 5-min Apgar score	__ __	□ not specified

1.11 Address

1.12 consanguinity:

1.13 Mode of delivery

Vaginal	□ yes	□ no	
Forceps	□ yes	□ no	
Vacuum	□ yes	□ no	
Caesarean section before onset of labour	□ yes	□ no	
Caesarean section after onset of labour	□ yes	□ no	
	□ not specified		
1.14 Antenatal corticosteroids (any)	□ yes	□ no	□ not specified
Antenatal corticosteroids (7 days to 24 h before birth)	□ yes	□ no	□ not specified
1.15 TORCH infection	□ yes	□ no	□ not specified
1.16Premature rupture of membranes (PROM)	□ yes	□ no	□ not specified

3. Diagnoses and clinical course (until demission)	Diagnoses according to given definitions!

3.2 RDS grade	□ yes	□ no	□ not specified
3.3 Pneumothorax	□ yes	□ no	□ not specified
3.4 Pulmonary interstitial emphysema (PIE)	□ yes	□ no	□ not specified
3.5 Apnea	□ yes	□ no	□ not specified
3.6 TTN(transient tachypnoea of newborn)	□ yes	□ no	□ not specified
3.7 Postnatal asphyxia	□ yes	□ no	□ not specified
3.8 Congenital sepsis	□ yes	□ no	□ not specified
If yes:			
Positive blood culture	□ yes	□ no	□ not specified
If yes: identified germ	_____ □ not specified		
3.9 Congenital pneumonia	□ yes	□ no	□ not specified
3.10 Nosocomial sepsis	□ yes	□ no	□ not specified
If yes:	□ yes	□ no	□ not specified
Positive blood culture			
If yes: identified germ	_____ □ not specified		
3.11 Nosocomial pneumonia	□ yes	□ no	□ not specified
If yes:	□ yes	□ no	□ not specified
Positive culture from tracheal secretion			

If yes: _____

identified germ

□ not specified

3.12 meconium aspiration syndrome
3.13 malformation in upper airway,malf. In the Epiglotis
tracheoalacia,bronchomalacia,trachoesop.fistula
3.14 post operative diph hernia,phrenic nerve palsy,oe, atresia
3.15 weaning from ventilator

3.16 CPAP □ yes □ no □ not specified

__ __ __ days □ not specified

3.17 O_2-dependence □ yes □ no □ not specified

__ __ __ days □ not specified

Pharmacologic therapy:

3.18 Antibiotic therapy □ yes □ no □ not specified

3.19Surfactant therapy □ yes □ no □ not specified
number of applications __ __

3.20 NO therapy □ yes □ no □ not specified

3.21 Postnatal corticosteroids (PNCS)

Hydrocortisone □ yes □ no □ not specified

Dexamethasone □ yes □ no □ not specified

Duration of PNCS therapy: __ __ days

3.22Transfusions □ yes □ no □ not specified
Type of blood product: _____

□ not specified

3.23 Further therapy

Documentation at time of demission

3.24 ROP	□ yes □ no □ not specified grade __ __ □ not specified
3.25 IVH	□ yes □ no □ not specified grade __ __ □ not specified
3.26 BPD	□ yes □ no □ not specified grade __ __ □ not specified
3.27Seizures	□ yes □ no □ not specified
3.28 Pathologic muscle tonicity	□ yes □ no □ not specified
3.29 PDA	□ yes □ no □ not specified □ surgical therapy □ pharmacologic therapy □ not specified
3.30 NEC	□ yes □ no □ not specified □ surgical therapy □ not specified
3.31 Pathologic newborn metabolic screening	□ yes □ no □ not specified
If yes: diagnosis	_____

	☐ not specified
3.32 Further diseases	_____
3.33 Surgeries	_____
3.34 Duration of NICU stay	__ __ __ days ☐ not specified
3.35 Transfer to another hospital	☐ yes ☐ no ☐ not specified reason: _____ ☐ not specified
3.36 Death (reason according to autopsy findings or documented in death certificate)	☐ yes ☐ no ☐ not specified reason: _____ ☐ not specified

***Exclusion criteria*:**

- Birth weight > 5kg
- Lethal deformities (bilateral renal agenesis, trisomie 13, trisomie 18, Potter`s syndrome, anencephalus)

Birth malformations:

- severe deformities:
- Diaphragmatic hernia
- Hydrops fetalis
- urea cycle defect
- aortic coarctation (severe form)
- tetralogie of Fallot
- omphalocele
- polycystic renal degeneration
- pulmonary hypoplasia

- Siamese twins
- Prune-belly-syndrome
- VACTERL-association
- CHARGE-assoziation
- Imperfect osteogenesis

4.1 Blood count

CRP	__ __.__ __	mg/l
erythrocytes	__ __.__ __	10^6/µl
haemoglobin	__ __ __	g/l
haematocrit	__ __.__ __	l/l
leukocytes	__ __._ __	10^3/µl
neutrophiles	__ __.__ __	10^3/µl
segmented neutrophiles	__ __.__ __	10^3/µl
stab cells	__ __.__ __	10^3/µl
thrombocytes	__ __ __	10^3/µl
creatinine	__ __.__ __	mg/dl
total serum bilirubin	__ __.__ __	mg/dl

Appendix 3

Consent Form

I hereby consent to take part in the study (Effect of CPAP application on new born baby to decrease neonatal mortality rate in NICU Slemani city /Kurdistan - Iraq).

My participation is voluntary. I have been informed about the study and its implications as well as the confidentiality with which the data is going to be handed. I understand that I do not need to answer every question during this interview and can discontinue it at any time if I wish to do so.

Parent Signature ---------- Date ---------

Doctor or Research assistance Sig. ---------- Date --------